APRIL, 1984

THE INDIAN FORESTER

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कदम
ANTHOCEPHALUS CHINENSIS
भारतीय वन विद्यालयों के
वार्षिक दीक्षान्त समारोह
के अवसर पर भारत के राष्ट्रपति
ज्ञानी ज़ैल सिंह
द्वारा रोपित दि. 2.4.1984

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INDIAN FORESTER

Vol. 110 April, 1984 No. 4

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FRONT COVER

CEREMONIAL TREE PLANTING OF A KADAM (*ANTHOCEPHALUS CHINENSIS*) SAPLING BY HON'BLE GIANI ZAIL SINGH, PRESIDENT OF INDIA, AT F.R.I. AND COLLEGES, DEHRA DUN.

Photo—Tilak Raj

CONTENTS

EDITORIAL

ARTICLES

AFFORESTATION FOR AVALANCHE PREVENTION AND CONTROL.
K.M. Tiwari, H.N. Mathur and R.P. Singh ... 329

PHYSIOLOGICAL STRAINS OF FOREST WORKERS.
B.P Maleta and K.G. Sood ... 337

ANALYTICAL STUDY OF TEAK PROVENANCE TESTS IN NORTH RAIPUR DIVISION OF MADHYA PRADESH. S.K. Suri ... 345

FIREWOOD CROPS IN AREAS OF BRACKISH WATER. A.N. Chaturvedi... 364

SCRUB FOREST STUDIES—FOLIAR AND SOIL NUTRIENT STATUS OF *PROSOPIS JULIFLORA* DC. B.M. Sharma ... 367

CUTTINGS TAKEN FROM BOTTOM ONE-THIRD PART OF *POPULUS CILIATA* PLANTS PERFORM BETTER.
R.V .Singh, K.C. Sharma and P.S. Kaushal ... 375

METALLIC PROPERTIES OF A NATURAL FIBRES REINFORCED COMPOSITE—BAMBOO. U.C. Jindal ... 381

PROVISIONAL GROWTH ESTIMATE OF *PTEROCARPUS DALBERGIOIDES* (ANDAMAN PADAUK).
S.P. Singh, R.S. Sharma and Jai Singh ... 396

HIGH YIELD PULPS FROM KENAF.
Y.K. Sharma, Rita Dhawan and B.G. Karira... 401

★

BACK COVER

KADAM (*ANTHOCEPHALUS CHINENSIS*) IN FLOWER

Photo—Courtesy Photo Section
F.R.I. & Colleges,
Dehra Dun

BEEKEEPING, POLLINATION AND PLANT PROPAGATION.
M.C. Suryanarayana, G. Mohana Rao and R P. Phadke ... 407

EFFICACY OF EGG PARASITE, *TRICHOGRAMMA* SPP. IN PARASITISING THE EGGS OF THE TEAK SKELETONIZER, *PYRAUSTA MACHAERALIS* WALKER (LEPIDOPTERA : PYRALIDAE)
B.V. Patil and T.S. Thontadarya ... 413

RESEARCH NOTE ... 419

CONVOCATION OF FOREST COLLEGES, APRIL 1984 ... 421

OBITUARY Art Paper

GAZETTE NOTIFICATIONS ... vii

VOLUME 110 NUMBER 4

THE
INDIAN FORESTER

APRIL, 1984

EDITORIAL

The second of April, 1984 was a memorable day in the history of the Forest Research Institute and Colleges, Dehra Dun, when the President of India, Hon'ble Giani Zail Singh addressed the combined convocation of the Forest Colleges and Social Forestry Diploma Course at the Forest Research Institute and Colleges, Dehra Dun. Shri Rao Birendra Singh, Minister for Agriculture also graced the occasion and spoke to the distinguished gathering. Shri C.S. Kirpekar, President, F.R.I. and Colleges, Dehra Dun, welcomed the Chief Guest and the vote of thanks was given by Shri C.L. Bhatia, Inspector General of Forests. A resume of the proceedings of the historic convocation is given on page 421.

* * *

In the cover photo of this issue shows the Ceremonial Tree planting of a Kadam sapling by Hon'ble Giani Zail Singh, President of India, in the Mango Grove on the northern side of the main building of the Institute after the convocation ceremony.

* * *

In the lead article of this issue the authors suggest about the control of avalanches by afforestation with both coniferous and broad leaved species. Pre-requisities for improvement of avalanche prone area have also been discussed.

* * *

On page 367, the author writes about foliar and soil nutrient status of *Prosopis juliflora* D C. in the Thar Desert of India.

* * *

The author on page 381 has determined the useful mechanical strength properties of bamboo (solid and hollow) coated with araldite/hardener mixture. He has also proved that the mechanical behaviour and mode of fracture of bamboo specimen under various types of loading are similar to those of artificially developed fibre-reinforced composites.

* * *

On page 401, the scientists of the Cellulose and Paper Branch of F.R.I. and Colleges, Dehra Dun write about the newsprint grade high yield pulp from Kenaf.

R.S. Mathur,
Hony. Editor.

AFFORESTATION FOR AVALANCHE PREVENTION AND CONTROL

K.M. TIWARI*, H.N. MATHUR** AND R.P. SINGH***

Forest Research Institute and Colleges, Dehra Dun (India)

Introduction

"No Avalanche structural control without afforestation" that is without restoration of the protective forest, shows clearly and unambiguously that only forest Engineer is in a position to meet these requirements (Anon, 1975).

Usually trees can do little to control on avalanche after the snow has begun to slide. The snow will first rush between the trees and then as it gathers the speed and weight, it will take the trees with it. But extensive tree plantings where the avalanches start—anchor the snow and prevent the avalanche from ever happening (Anon, 1954). The above quotes clearly indicate the importance of afforestation in avalanche control and protection projects as well as the limits.

The Problem

"The instability of snow in mountainous regions may lead to sudden downward movements of the snow - this is known as Snow Avalanches" (Chow, 1964). The avalanche is a natural phenomenon that suddenly releases great natural forces like lightening, tornadoes, floods and earth quakes. Dry powder snow avalanches are fastest moving, whereas wet snow avalanches are slowest. Church (1949) refers to Mougin's and Bernard's estimate of the speed of wet snow avalanche as being 25 km/hr on a slope of 45° whereas the speed of Dry powder snow avalanche, on an average was estimated to be 350 km/hr on slope of 44° at Glarnisch (Switzerland) in March 1898. The above rates are indicative of speeds at which avalanche can move—the damage these can cause can be imagined. The forest—destructive avalanches of Vanadi, lower Engadin Switzerland measures, 5.5 km^2 and it was 3.6 km long and 1.5 km wide.

Avalanche damage Avalanches can cause losse of life and property. Properties would include habitations, buildings, facilities and ameneties; transportation - removal and avalanche deposits, damage to road surface and bridges; Land-Forests, agricultural lands, orchards, pastures; communication lines like telephones, power generation and transfer systems etc.

Paper presented in First National Symposium on "Seasonal Snow Cover" held on 28-30 April, 1983 in Vigyan Bhavan, New Delhi.

* Ex-President, Forest Research Institute and Colleges, Dehra Dun.

** Conservator of Forests, Environmental Research Stations, F.R.I. and Colleges, Dehra Dun.

*** Senior Research Officer, Environmental Research Station, Press Villa, US Club Estate, Simla.

Causes The causative factors can be classified into two main groups viz :

(1) Natural phenomena such as seismic activity, highwind velocity and heavy snowfall etc

(2) Biotic pressures due to increased human activities i.e. opening of new tourist areas, pilgrim centres, roads and building constructions, deforestation, mining activity etc

In the country, the avalanche problems are confined to North and North-Western Himalayas namely the States of Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh. Some well known places inflicted by chronic avalanches are near Badrinath temple, Kim-Khim in Uttar Pradesh, near the Banihal tunnel/Verinag on National High Way from Pathankot to Srinagar, Doda in Jammu & Kashmir and on Manali Rothang roads in Himachal Pradesh. These sites vary in elevation from 1900 m to 4500 m above m.s.l. About 15 avalanches were reported in Manali/Rothang area in Himachal Pradesh alone in 1981 and many go unreported in other parts. (Plate 1, 2).

Characteristics of Avalanche prone sites. Avalanche prone sites occur at high altitudes and have been reported from 1900 m to 4500 m elevation in the Himalayas on different aspects. Usually the slopes associated with the avalanches are long and steep. Big avalanches have been reported on 45° slopes in Switzerland. Snowfall of as much as 1200 cm per annum is recorded at some of the avalanche prone sites in the Himalayas. Winter snow form the main precipitation of these sites, heavy snowfall and its accumulation usually is associated with avalanches.

Avalanche sites are usually windy The soils are skeletal and exposed rocks, boulders of large dimension are common. Stumps broken and washed off trees are very commonly met within regular avalanche paths.

The Avalanche Scenario

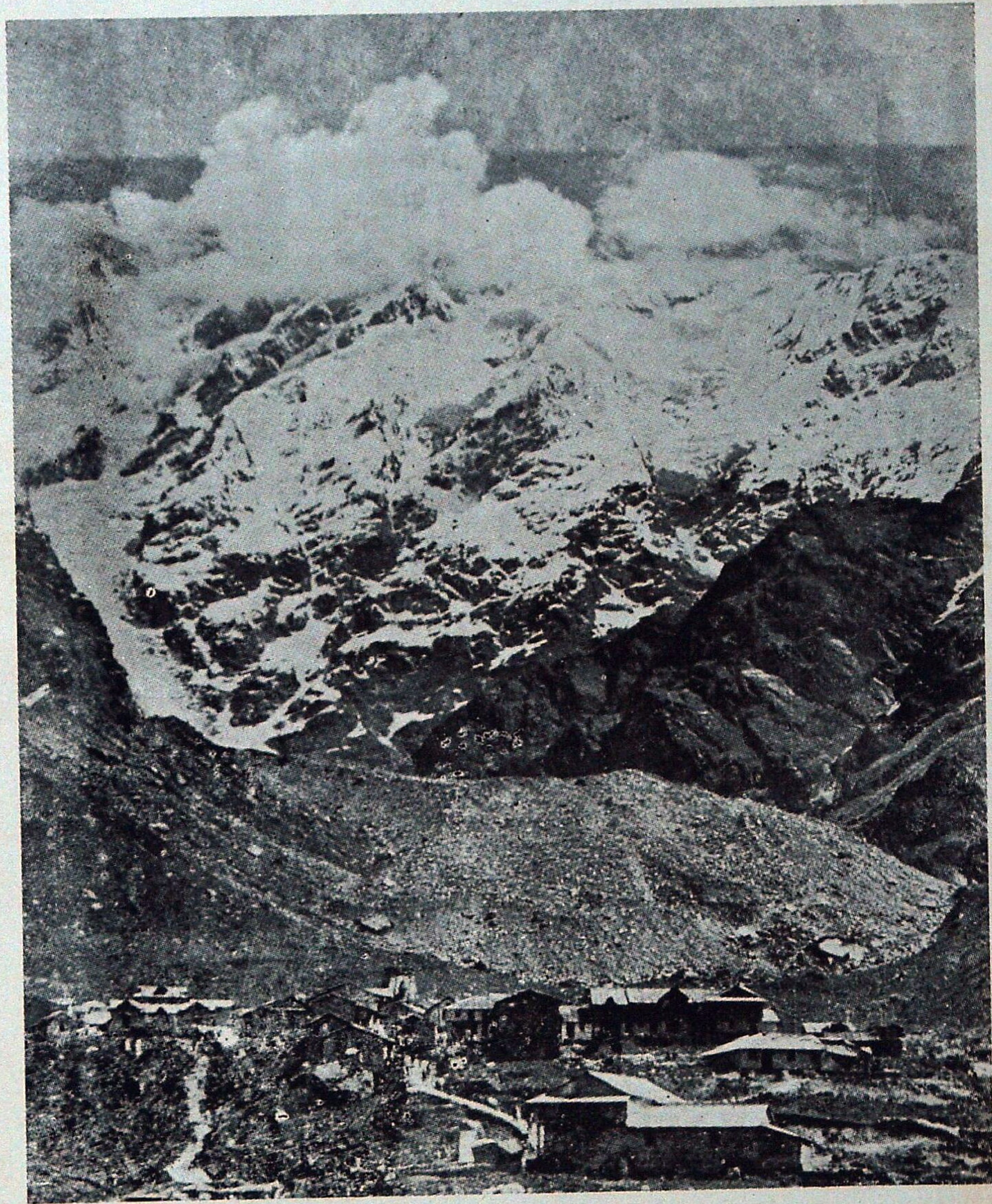
The avalanche scenario can be divided into two major groups namely :

1. Avalanche prone areas above tree line and avalanche paths.
2. Avalanche prone areas within the tree line and avalanche paths.

Avalanche prone areas above tree line are those which occur above the tree and vegetation line and where the control measures are essentialy engineering in nature. Once initiated the avalanche moves down the slopes, enters forest areas or agricultural fields or habitations and causes utter devastation. (Plate 3)

Avalanche prone areas within the tree line are those from where protective forest cover has disappeared due to excessive biotic interference, making them prone to avalanches. These areas which were earlier free from avalanche menace have now become very fragile and even little disturbance due to mining, blasting, transport movement can trigger avalanches. (Plate 4)

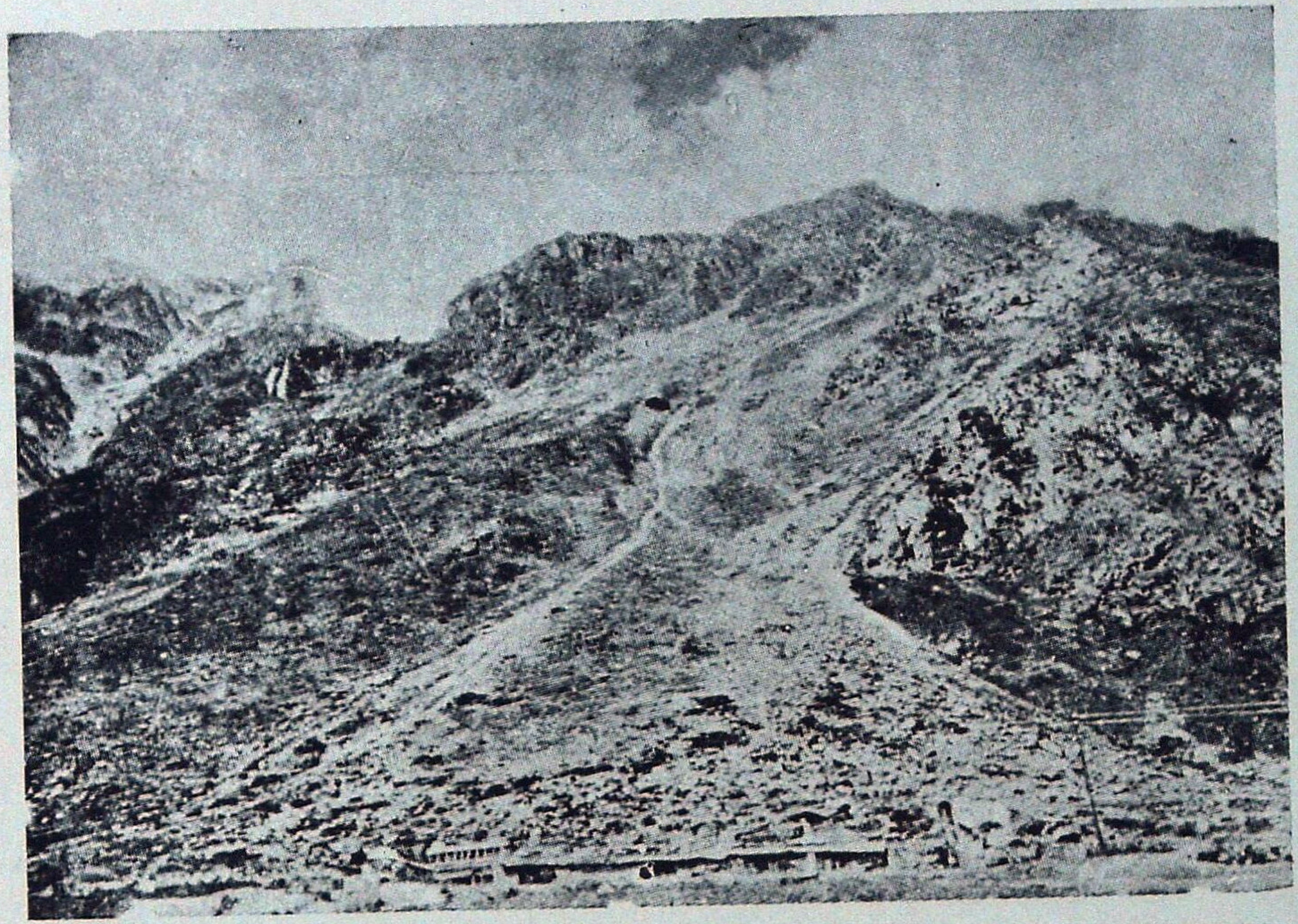
Plate 1



Avalanche Threatened Kedar Nath Shrine and Township (U.P.) in Central Himalayas

(Photo—M.M. Bahukhandi)

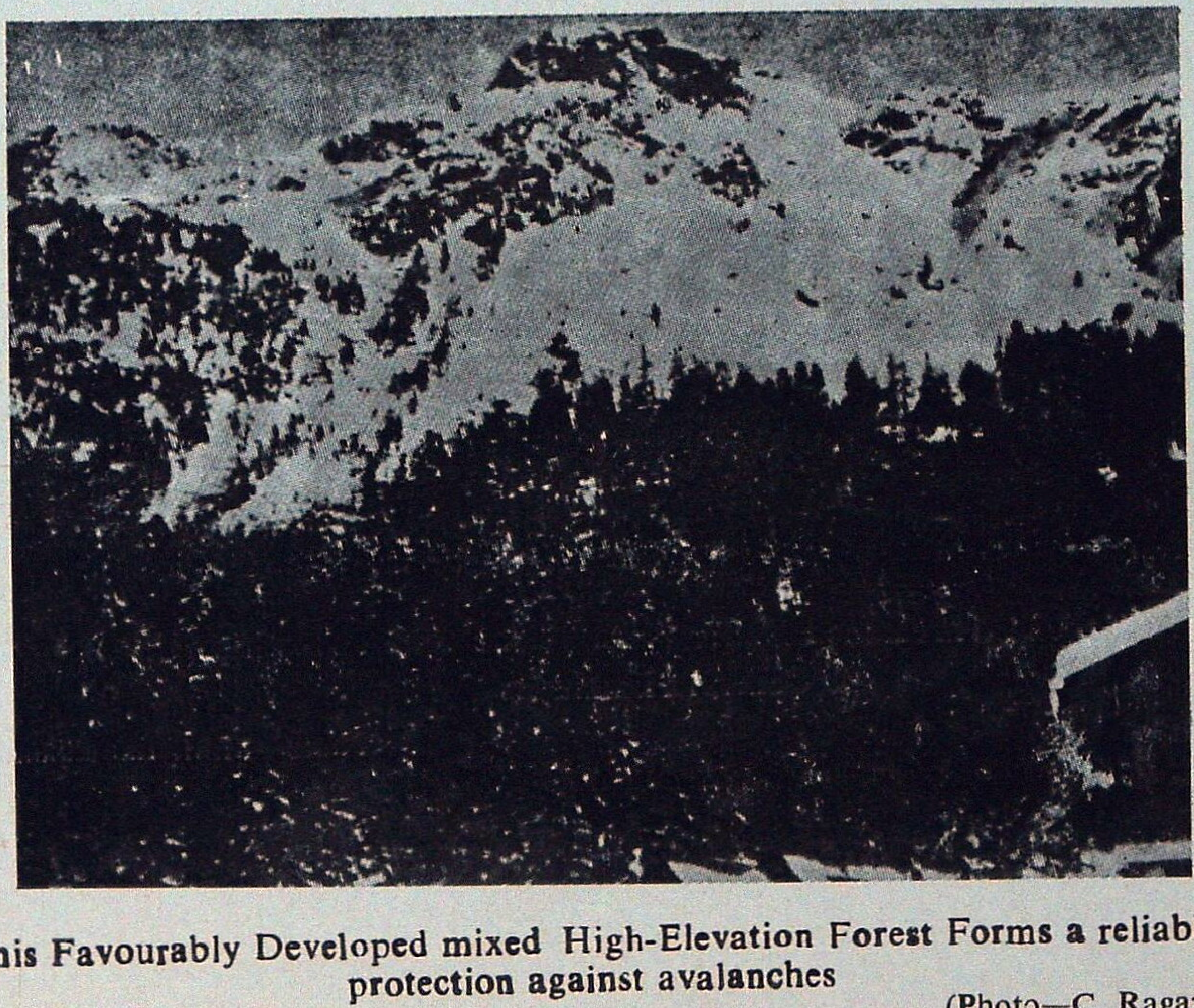
Plate 2



Avalanche Threat to Badrinath Shrine Chamoli Disstt. (U P.) in Central Himalayas and Township where avalanche control structures are contemplated by Snow and Avalanche Study Establishment, Manali (H P.)

(Photo—M.M. Bahukhandi)

Plate 3



This Favourably Developed mixed High-Elevation Forest Forms a reliable protection against avalanches

(Photo—C. Ragaz)

Prevention of Avalanche

Treatment of areas above timber line. The prevention of avalanche initiation in areas above timber line is through structural measures, to be designed and executed by competant Civil or Forest Engineers as the case may be. (Plate 5)

Once at the tree line altitude the treatment will be :

(1) Use of mechanical measures to divert, diffuse snow slides away from the forest, pastures, orchards, agricultural fields, habitation and safely dispose the moving snow. Below these diversions protective afforestation has to be carried out to restore the vegetative cover, the details of which are discussed under afforestation of timber zone. (Plate 6)

Treatments of areas within timber line. This will consist of two major items of work namely (a) Location of areas prone to snow drift and small movement of snow slabs and erection of protection structures like snow fences and rakes of various types and design. (b) The rest of the areas, where afforestation will be carried out without snow fences etc. (Plates 7 & 8).

Afforestation

Afforestation of reforestation or Avalanche prone areas would mean, in our conditions planting of different species in large numbers over lands hitherto open to grazing and unrestricted public use. The major decision in this programme is to select suitable plant species for the purpose. Ragaz (1975) has recommended some specifications for afforestation of avalanche prone areas.

(a) *Choice of species.* "It has been asserted that every tree variety displays advantages and disadvantages with respect to avalanche protection. Therefore, a mixture of tree varieties promise to produce the best results and one should avail one-self of every possible extension of the tree variety spectrum even employing deciduous trees". Apart from this wide spectrum preference, we should consider the rate of growth, longivity, height growth, crown formation etc. Taking these in view one could possibly plant the following tree species.

Evergreen Coniferous species

Fir — *Abies pindrow*
Spruce — *Picea smithiana*
Deodar — *Cedrus deodara*
Kail — *Pinus wallichiana*

Evergreen broad leaves species

Oak — *Quercus semicarpifolia*
Salix — *Salix species*

Semi-deciduous broad leaves species

Boras — *Rhododendron aroboneum*
— *Rhododendron companulatum*

Deciduous brord leaves species

Populus species
Betula utilis
Exotic species
Larix species

As far as possible indigenous tree species acclamatized to the site should be preferred and for nursery work only locally available good quality seed should be used.

Spacing or Stand density. "The stand density which is necessary for an effective avalanche protection in the neighbourhood of the ground i.e. in the region of the snow deposit, can be best obtained by an ample restocking over the whole area of the stand. Hence the greatest significance should be accorded to suitable restocking measures and increased cultivation. These restockings should be kept densely closed upto a height of 3–4 m. Subsequently, suitable measures are necessary for the formation of wellcrowned, resistant individual trees". This would indicate an initial stocking of between 5000 – 10,000 seedlings at an spacement of 2 × 1 m or 1 × 1 m. This is an area for field experiments since no such work has been carried out. Slower growing species could be planted at 1 × 1 m and faster growing at 1 × 2 m. (Fig. 1).

Planting techniques :

Staking. Initially the area will have to be staked out at the desired spacing as discussed under stand density.

Pitting. Pits measuring 30 cm^3 will have to be prepared well in advance and planting of nursery raised seedlings will be carried out. Both nacked root plants and plants raised in pots will have to be tried out. The pots used should be biodegradable only. This is another aspect which requires field experimentation trials. Pit making can be done manually or by employing special designed instruments, depending upon the locality and site conditions.

Planting stock. Only healthy plants of sufficient height and diameter are to be planted. Tall plants, barbetels, rooted cuttings should be tried.

Casuality replacement. Where mortality is noticed it will have to be replaced by nursery raised plants kept in reserve for this purpose.

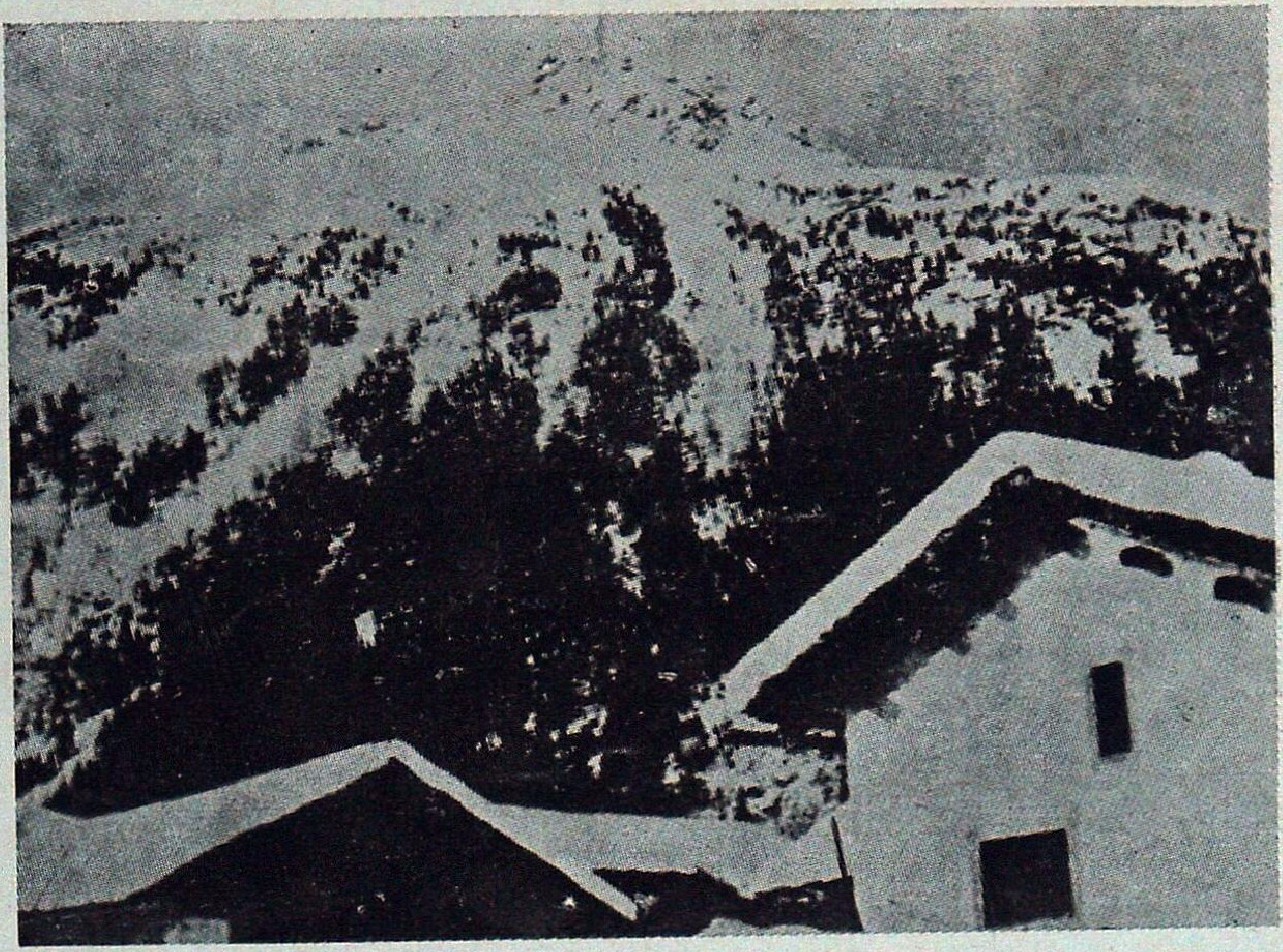
Nursery

A nursery is required for each work site so as to multiply the selected species for that area.

Use of growth boosting inputs :

Fertilizers. Due to the poor site conditions prevalent it would be necessary to use fertilizers/organic manure both in the nursery and field stage.

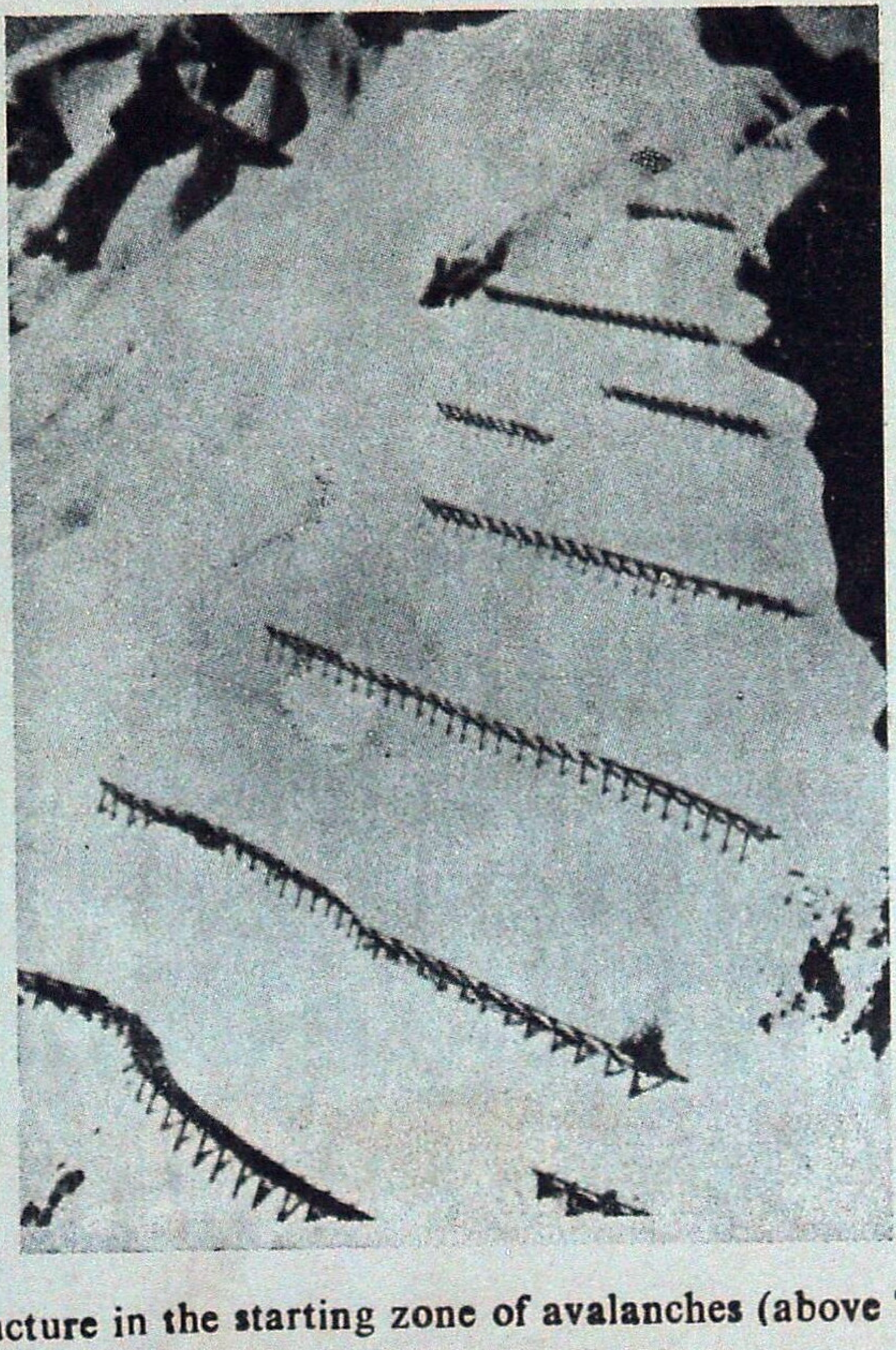
Plate 4



Protective Forest Penetrated by several avalanche paths; in such cases, artificial control structures are required in the starting zones in order to completely close the Forest belt once again

(Photo—C. Ragaz)

Plate 5



Control Structure in the starting zone of avalanches (above Timber Line)

Plate 6 (a)

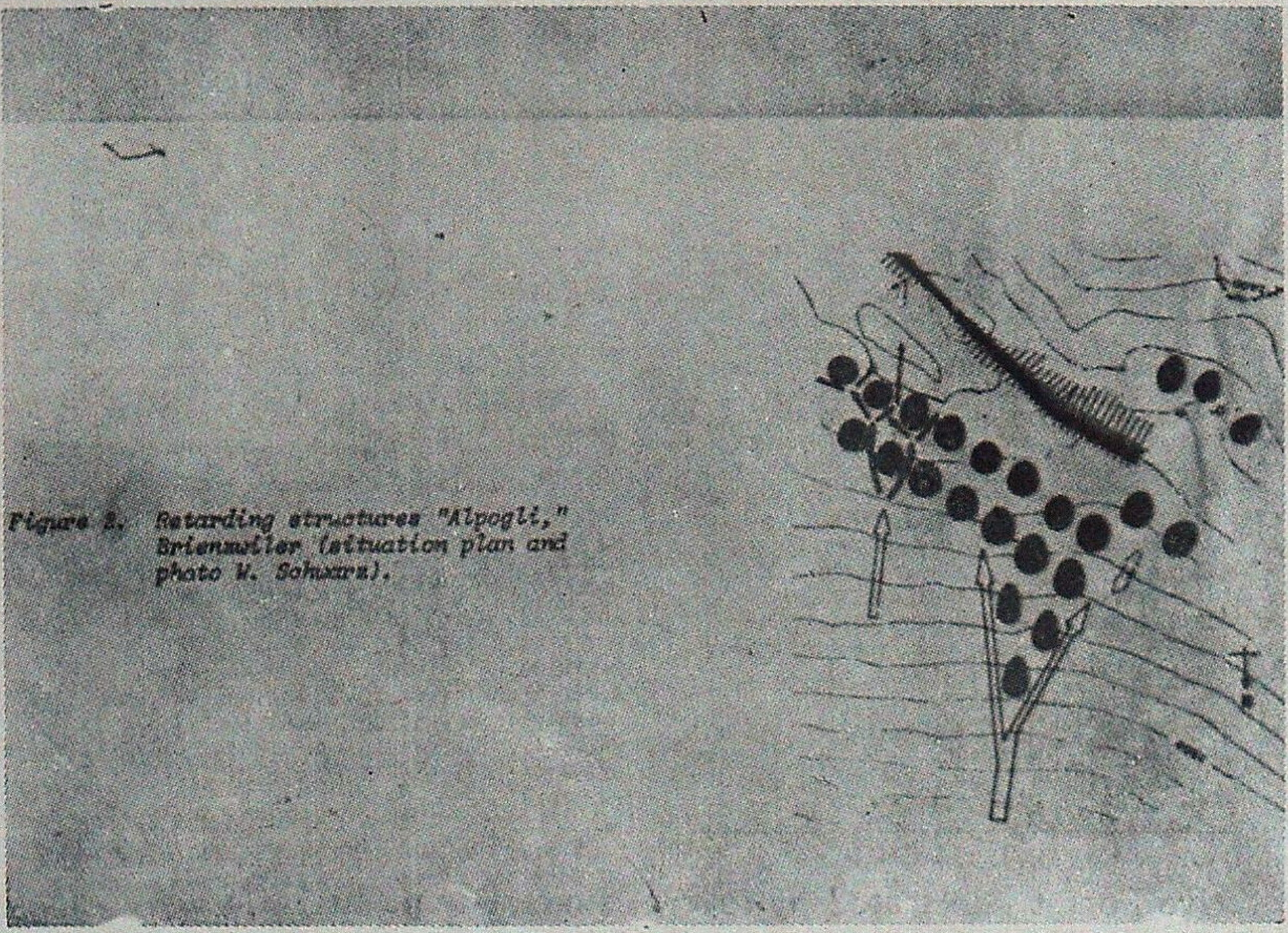
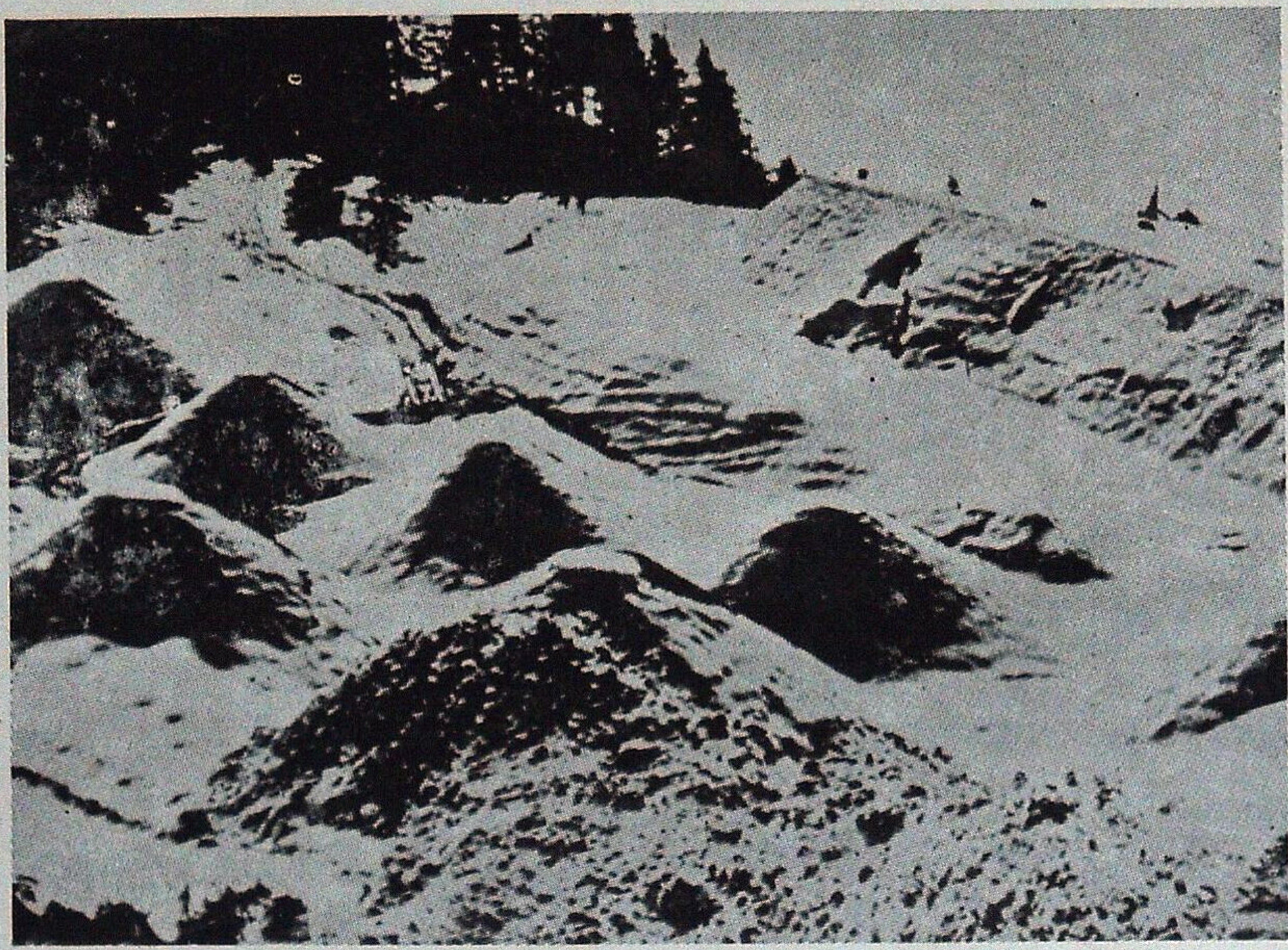


Figure 2. Retarding structures "Alpogli," Brienzwiler (situation plan and photo W. Schwarz).

Retarding Structures "Alpogli", Brienzwiler (Situation Plan)

Plate 6 (b)

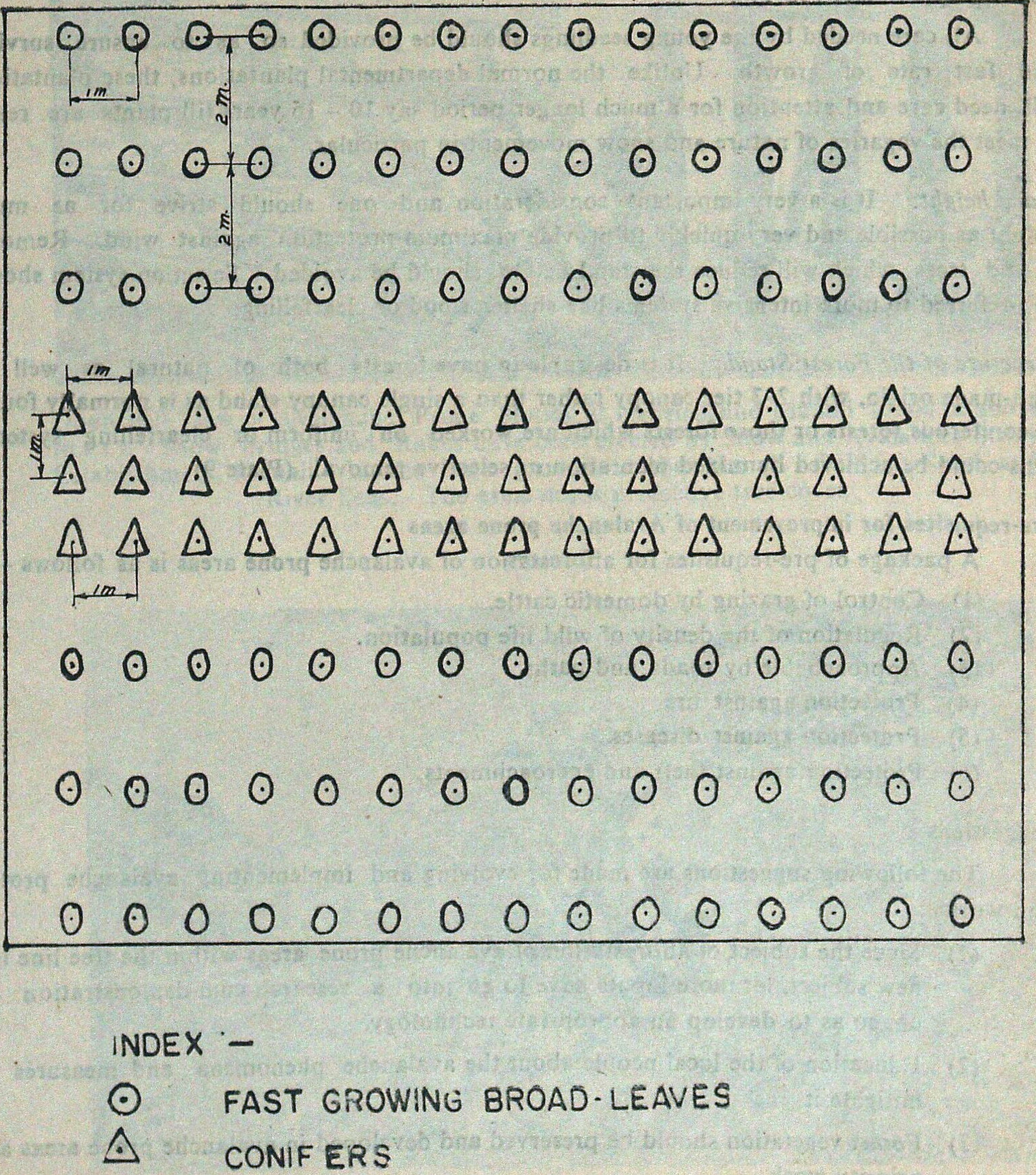


Retarding Structures "Alpogli", Brienzwiler

Fig. 1

FOREST STRUCTURE

AN AFFORESTATION PLAN


1m
2m.
2m.
1m
1m
1m
INDEX —
⊙ FAST GROWING BROAD-LEAVES
△ CONIFERS

Irrigation. Where such facilities exist these should also be tried, the basic idea is to produce a dense tree cover in the shortest time up to a height of 3 – 4 m.

Polythene tube covers. For protecting and boosting of the rate of growth of broad leaves Polythene tube covers could be tried.

Tending operations

All care needed by the young seedlings should be provided so as to ensure survival and fast rate of growth. Unlike the normal departmental plantations, these plantations will need care and attention for a much longer period say 10 – 15 years till plants are ready to meet the vagaries of nature and snow movement in particular.

Stand height. It is a very important consideration and one should strive for as much height as possible and very quickly to provide maximum protection against wind. Removal of old trees which will reduce the stand height, should be avoided. Selection system should be preferred to more intensive systems like shelter wood or clearfelling.

Structure of the Forest Stand : It is desirable to have forests both of natural as well as man-made origin, with 2–3 tier canopy rather than a single canopy stand as is normally found in coniferous forests or those forests which are worked on uniform or clearfelling systems. This could be achieved by mixed plantation or selective removal. (Plate 9)

Pre-requisites for improvement of Avalanche prone areas

A package of pre-requisites for afforestation of avalanche prone areas is as follows –

(1) Control of grazing by domestic cattle.
(2) Regulation of the density of wild life population.
(3) Approachable by roads and paths.
(4) Protection against fire.
(5) Protection against diseases.
(6) Protection against theft and encroachments.

Suggestions

The following suggestions are made for evolving and implementing avalanche protection works :

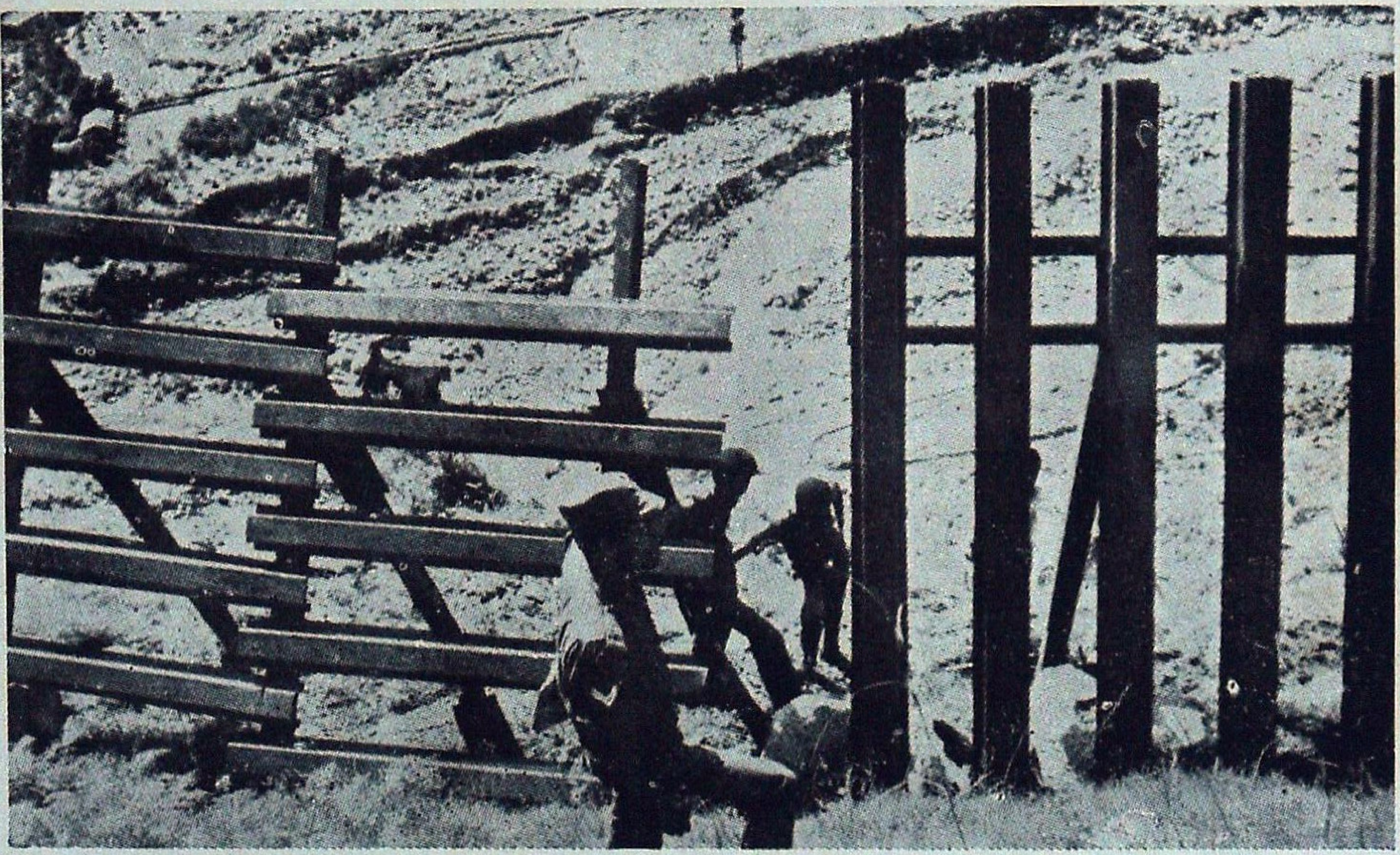
(1) Since the subject of afforestation of avalanche prone areas within the tree line is a new subject, lot more inputs have to go into a research-cum-demonstration set up, so as to develop an appropriate technology.

(2) Education of the local people about the avalanche phenomena and measures to mitigate it.

(3) Forest vegetation should be preserved and developed in avalanche prone areas as a priority work.

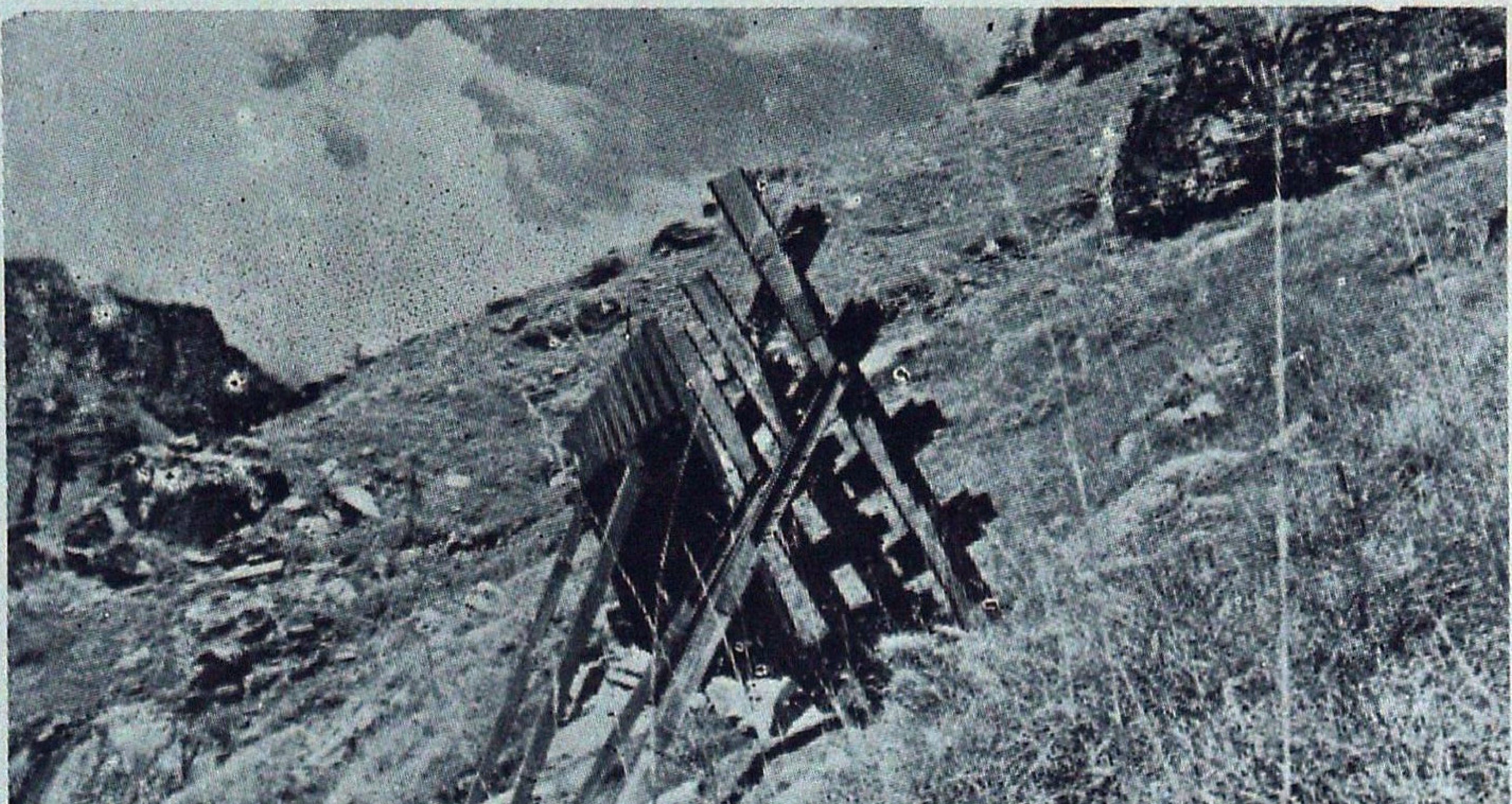
(4) Avalanche prone areas should be deleneated.

Plate 7



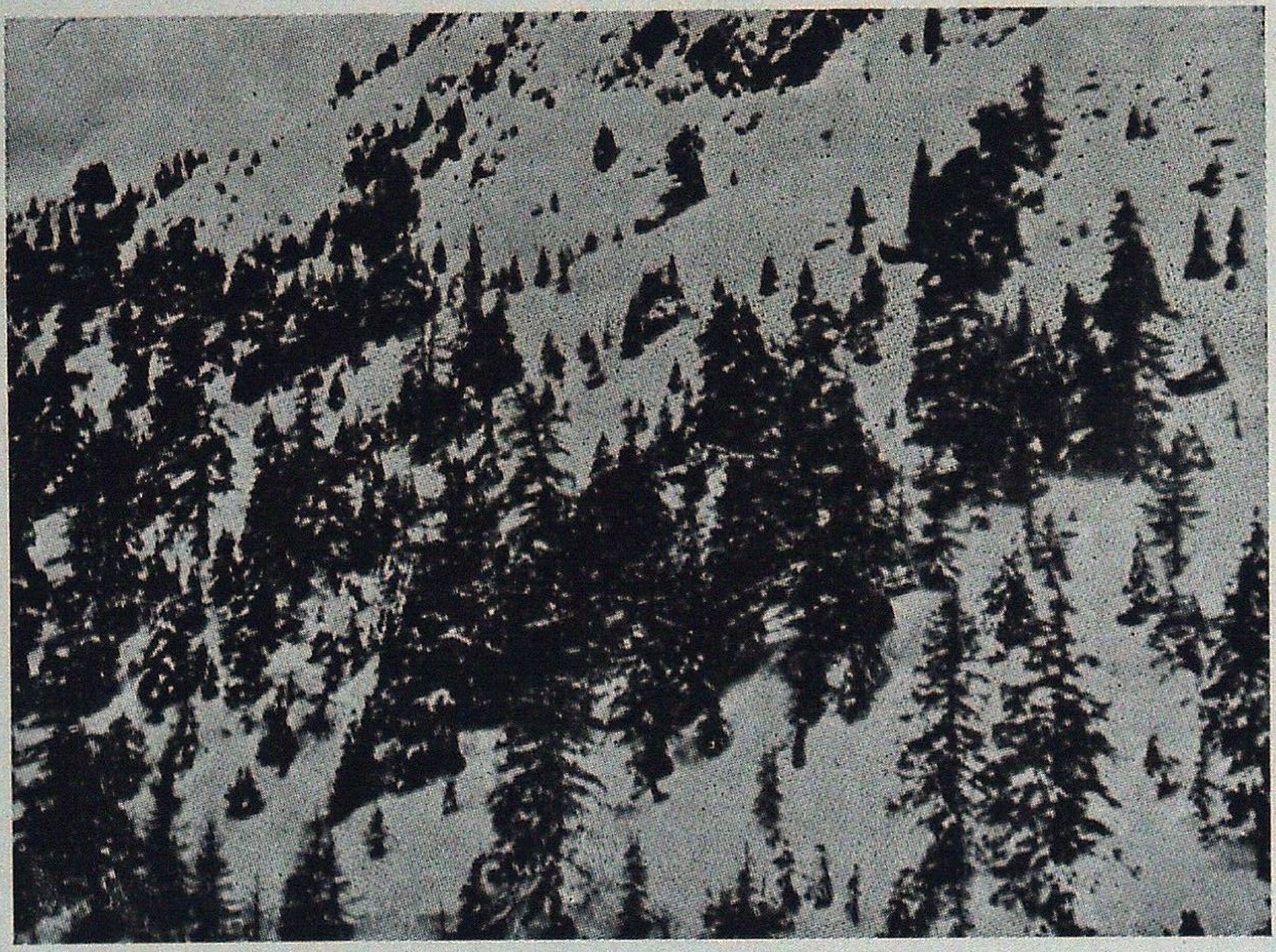
Doon Hill View of Avalanche Prone Slopes at Nehru Kund Manali (2500 m above m.s.l.). Snow Bridges and Rakes have been erected by Snow and Avalanche Study Establishment, Manali. In the back ground is the Manali - Rohtang Road and River Beas. The area needs protective tree cover

Plate 8



An Uphill View of an Avalanche control structure at Nehru Kund Avalanche Prone Site

Plate 9



A Larch-Cembran Pine Forest in process of developing at the upper tree line. It is already capable of a favourable effect upon the snow cover conformation and guarantees protection to the stand below

(Photo—C. Ragaz)

(5) Steep slopes should not be disturbed.

(6) It would be desirable to initiate a collaborative research/demonstration programme with the Snow and Avalanche Study Establishment (SASE) by locating afforestation stations in the States of Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh. The existing Environmental Research Stations of the Forest Research Institute and Colleges in Himachal and Jammu & Kashmir could be strengthened and a new one for Uttar Pradesh be created.

SUMMARY

Sudden downward movement of snow due to instability in the snow packs – generally known as avalanches, results in great catastrophies in the Himalayan region resulting in huge loss of life, property and facilities. Afforestation is considered to be very important for any avalanche protection work where avalanches start within the tree zone, trees anchor the snow and prevent the avalanche from ever happening. The present paper deals with various aspects of afforestation of avalanche prone sites to minimise avalanche occurrence on a short and long term basis. Both coniferous and Broad leaved species considered suitable for afforestation of avalanche prone sites have been listed. Guiding principles for choice of species, crop geometry, spacing required, crop height and density, structures of the forest and other details have been discussed. Pre-requisities for improvement of avalanche prone areas have been given and suggestions for future work made.

हिमस्खलन की रोकथाम और नियन्त्रण के लिये वनीकरण

लेखक के०एम० तिवारी, एच०एन० माथुर व आर०पी० सिंह

सारांश

बर्फ के जमाव की अस्थिरता के कारण बर्फ का एकाएक नीचे की ओर फिसलना, जिसे प्रायः हिमस्खलन कहा जाता है, हिमालयी प्रदेशों में बहुत विपदाजनक होता है जिसके फलस्वरूप जान, सम्पत्ति और सुविधाओं को बहुत हानि उठानी पड़ती है। हिमस्खलन रोधी कार्यों में, जहां हिमस्खलन वृक्ष क्षेत्रों के भीतर ही शुरू होता है, वनीकरण बहुत महत्वपूर्ण माना जाता है, क्योंकि वृक्ष बर्फ को थामते हैं और हिमस्खलन होना सदा के लिए रोक देते हैं। प्रस्तुत अभिपत्र में हिमस्खलन होने वाले क्षेत्रों में, अल्पावधि तथा लम्बी अवधि के आधार पर, हिमस्खलन होना न्यूनतम बना देने के लिये किये जाने वाले वनीकरण के विभिन्न पक्षों का विवेचन किया गया है। हिमस्खलन होने वाले क्षेत्रों में वनीकरण के लिये उपयुक्त मानी जाने वाली शंकुधर और पृथुपर्ण दोनों तरह की वृक्ष जातियों की सूची दी गई है। वृक्ष जाति का चुनाव करने के दिशादर्शन सिद्धान्त, फसल की भूमिति, वृक्षों के बीच में रखा जाने वाला फासला, फसल का घनत्व और ऊंचाई, वनों की संरचनाएं और अन्य बातों पर विमर्श किया गया है। हिमस्खलन उन्मुख क्षेत्रों को सुधारने की पूर्वापेक्षाएं बताई गई हैं तथा भविष्य में कराए जाने वाले काम के सम्बन्ध में सुझाव दिये गये हैं।

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PHYSIOLOGICAL STRAINS OF FOREST WORKER

(A case study in Tropical Hardwood Forests of Central India)

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Introduction

Basic requirement of forest workers is high capacity to perform physical work. Forestry works, as tree felling, conversion, log handling and transportation are highly physically demanding than any other rural works in agriculture and construction works. The forestry works are carried out by unorganised and mostly unskilled rural work force. The work methods are manual, the tools are often traditionally old fashioned and ill-maintained. The rural workers have no education and no opportunity to improve their skill and work technique through vocational training. They are subjected to unreasonably high physical workload to earn meagre daily wages. There are cases of malnutrition leading to occupational diseases, deformities and other health problems. Improvements in work methods, tools and implements can result in reducing the physical efforts and increase in work output. There is little information available on workload and work capacity norms of forest workers. The occupational workload of forest worker need to be determined not only in relation to energy expenditure on each operation of work but also in terms of individual capacity to perform work under various environmental conditions and work situations.

The present study has been conducted in the tropical hardwood forests of Central India in Bhandara Forest Division of Maharastra State. The objective of the study is to determine the physical work capability in terms of aerobic power capacity, workload demands and nutritional status of average forest worker engaged in tree felling and cross-cutting operations by improved manual saws.

Methodology

Study area and experiment. The field experiment was done in January-February, 1982 in Compartment No. 23 and 130 of Kakazari Forest Range in Bhandara Forest Division of Maharastra State, (latitude 21°-21°43′ and longitude 79°27′-80°).

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The topography of the area was generally flat with undulation, low hillocks and bouldary ground. The climate is hot with average annual rainfall of about 1300 mm. The temperature during study period in January-February varied from 14°C to 26°C. The forests are Tropical Dry Deciduous. The natural stand mainly consisted of middle aged tree of Saj (*Terminalia tomentosa*), Garari (*Cleisthanus collinus*), Lendia (*Lagerstroemia parviflora*), Dhaura (*Anogeissus latifolia*), Mohwa (*Bassia latifolia*), Tenda (*Diospyros melanoxylon*), Bel (*Aegle marmelos*) etc. The cutting experiments were confined to the tree species of more or less the same density wood. The area was under clear felling for raising teak by planting.

The working tools used were mostly traditional peg-tooth saw and axe with poor maintenance. The improved peg-tooth saws and a few raker saws provided to the workers were in varying condition of maintenance from bad to worst, as the workers were not trained in saw maintenance nor the maintenance kits were provided to them. The experiments were, however, carried out with properly maintained improved peg-tooth and raker saws. (Plate 1, 2)

Health Survey. Detailed household interview was done for forty four forest workers, having apparently average physical fitness. The physical characteristics are summarized below (Plate 1, 2).

Number of workers	... 44
Age in years	... 26.48 ± 6.27
Body weight in kg	... 48.32 ± 12.27
Height in cm	... 157.29 ± 28.40
Family size in number	... 4.8 ± 1.5
Earning members	... 2.1 ± 1.1
Monthly earning from logging jobs	... 116.79 ± 19.6

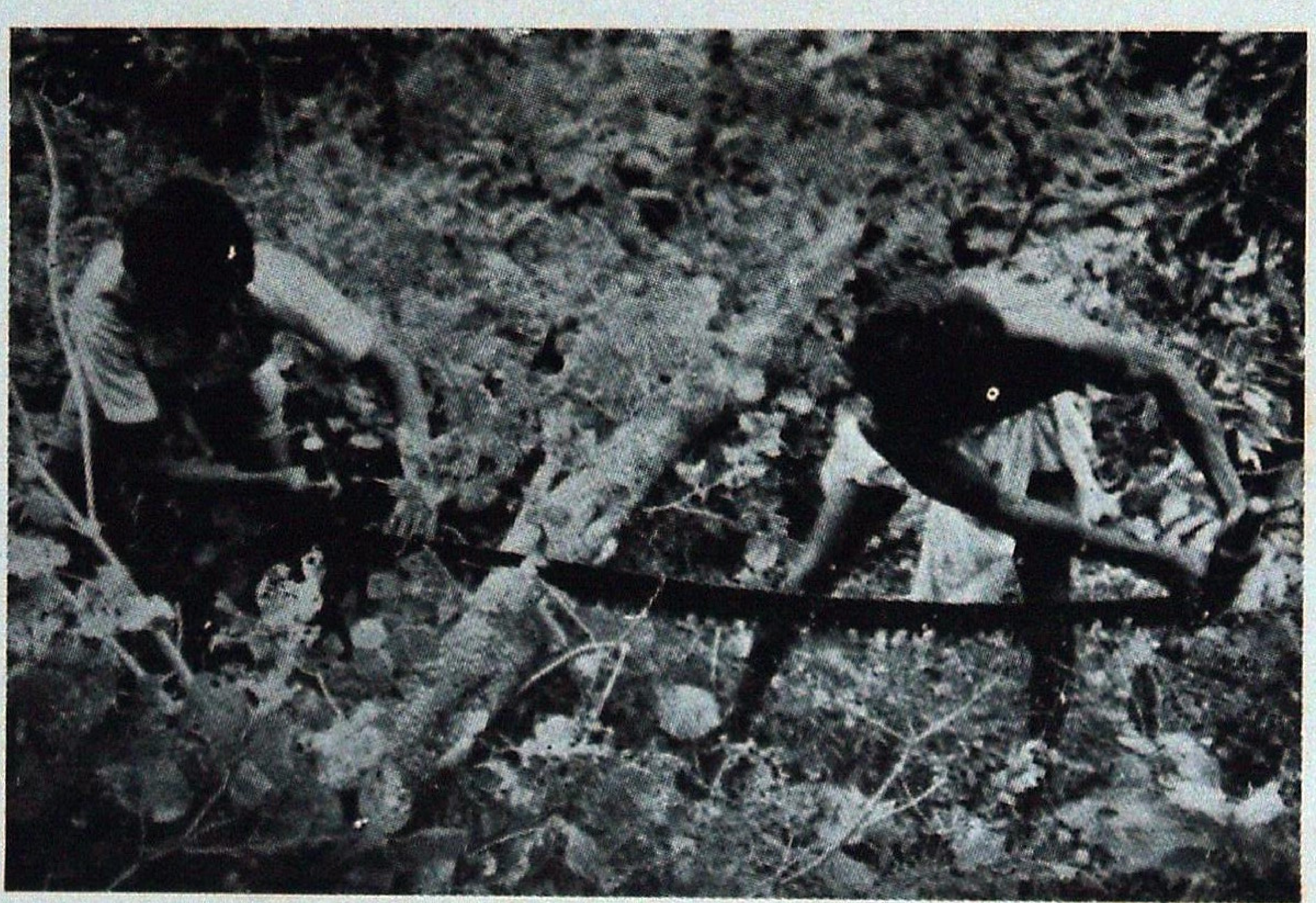
All the workers were receiving cereals and oils at subsidised rates as part of their wages under a food-aid programme. Some other interesting informations were also collected. 87.4% of workers interviewed were tobacco addicts, 57.3% liked to take alcohol 2–3 times a week. 22.7% complained of arm–pain, 18.2% of back-ache, 4.5% foot injury and 4.5% complained of stomach disorder. Only three workers reported having seen one or two fatal accidents on forestry works. They had been cases of serious injury on accidents, only three workers were reportedly involved themselves in serious accidents on forestry works and received injuries.

An estimate of food intake by average forest worker has been made on the basis of the household survey carried out for 44 workers. The following table gives the best assessment made.

Plate 1

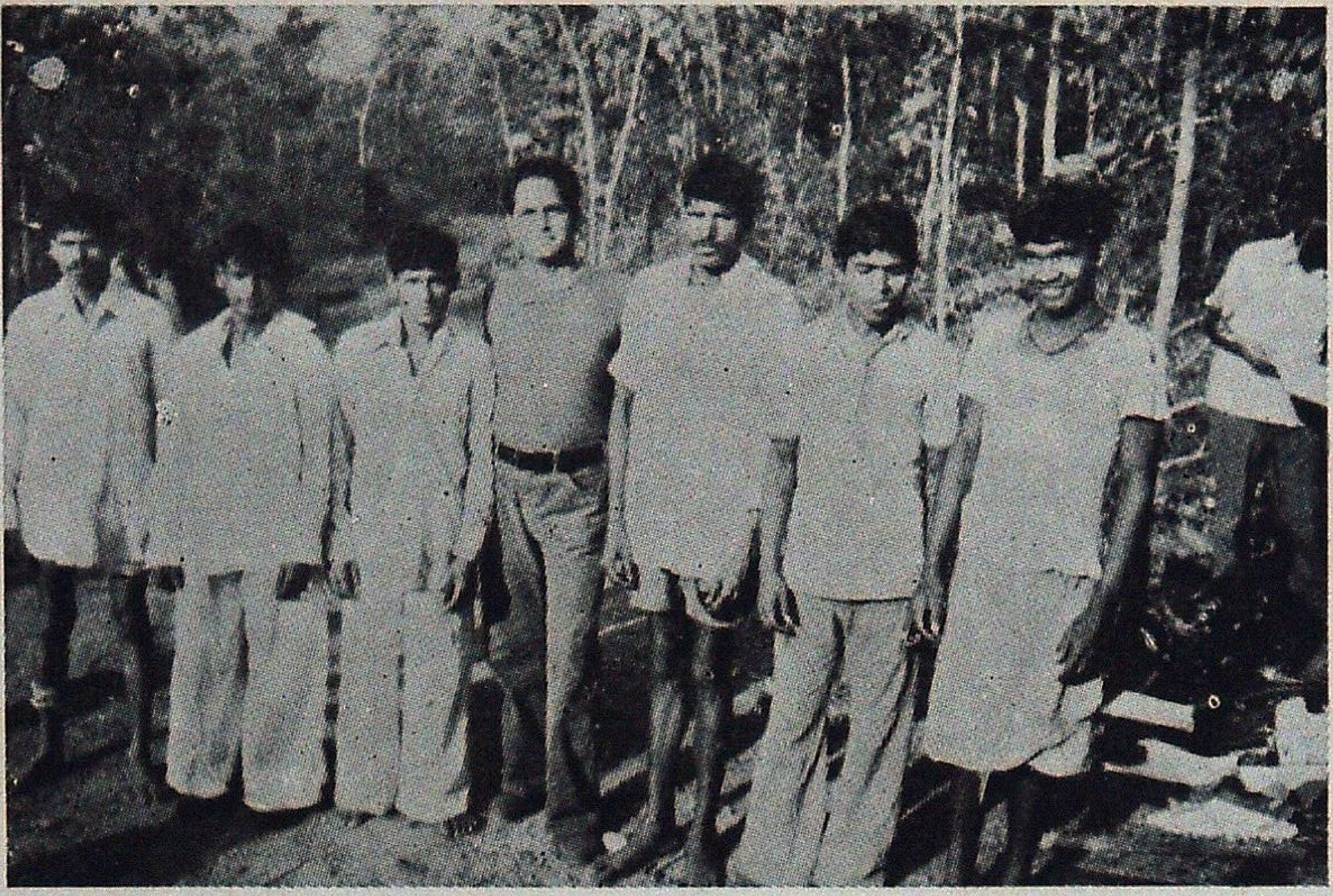
Tree felling with axe and saw

Plate 2



Cross-cutting-work posture

Plate 3



Author with a group of forest workers—research subjects

Plate 4

Field research party preparing for day's work

Table 1

Average daily food intake and its calorific and nutritional value

Food item	Quantity per day (gm)	Kcal	Protein (gm)	Fat (gm)	Carbohydrates (gm)
Rice boiled	571	799	12.56	1.71	168.93
Wheat	312	798	27.78	8.43	139.51
Pulses	40	141	9.98	1.25	24.95
Fats and oils	42	432	—	41.96	—
Meat and fish	55	88	22.00	1.49	—
Vegetables	150	84	1.89	—	17.93
Tea with milk	400 ml.	48	—	8.00	12.00
Alcohol	375 ml.	62	—	—	—
Total	1170 gm. 775 ml.	2452	74.21	62.84	363.33

The main source of calories and nutrients are cereals, pulses and oils. Protein from vegetable sources is inferior to animal protein of which the intake is negligible. The above intake of food by the workers includes the food materials received by the workers in food-aid programme presently implemented in the area. The workers take the food grains and other food materials received as part of their wages to their houses and is shared with other members of the family.

Selection of Subjects and physiological measurements. Ten physically active young workers from a group of forest workers engaged on wood harvesting works were selected as test subjects on the basis of their willingness and physical fitness. They were medically examined by qualified doctor before they were subjected to workload for determining the maximal aerobic power. The body weight, height and resting pulse rates were recorded. The bicycle ergometer (Monark Crescent AB, Sweden) has been used for physical exercise test to determine the maximal oxygen uptakes. The subjects were accustomed bicycle riders and no training on bicycle ergometer was needed. However, the workers were acquainted with the experimental requirements. The workers pedalled at the rate of 50 revolution per minute for 4 to 5 minutes for steady state, starting from 1 kp i.e. 300 kpm/minute workload increasing gradually by 1 kp and later by half kp. The whole test for each individual was spread over two days and standard procedure has been followed. Care has been taken that the highest pulse rate did not exceed 150 per minute and the highest load has been so restricted. Heart rate was measured by timing 10 beats with a centiminute stop watch. The maximum workload taken by the worker was 900 and 1050 kpm/minute only, this may not be a true maximal but the workers were not willing to take higher loads (Plate 3, 4).

The pulmonary ventilation at different workload was determined by collecting the expired gas samples in rubber bladder through Max-Planck respirometer by mouth piece and nose-clip arrangement. The expired air was collected for the last 2 minutes during the steady-state condition for each workload. The respirometer apparatus was held by the subject on his back while working. The oxygen uptake was determined by analysing the aliquots of expired gas in Orsat Gas Analysis apparatus and the energy expenditure was computed by Weir's method.

Experimental procedure on logging operations. Physiological responses and energy expenditure have been studies on tree felling and cross-cutting operations by improved and properly maintained raker and peg-tooth two-man saws and also by local axe. Seven out of the selected ten test subjects were studies on field operations in natural working environment. For each individual 5 to 10 samples were collected for each operation of work and on each working tool. The samples collected on each subject have been well dispersed over his full working day. The field study have been carried out during three weeks period, allowing full fifteen working days. Time study data were also recorded alongwith pulmonary function test on tree felling and cross-cutting operations.

Work and time studies were also carried out in the same area during the same period, in order to find the actual working time of forest workers engaged in felling and cross-cutting operations and work time distribution on various elements of jobs of different workload. This has been used to determine total energy expenditure of forest worker on full day's job. (Plate 5, 6).

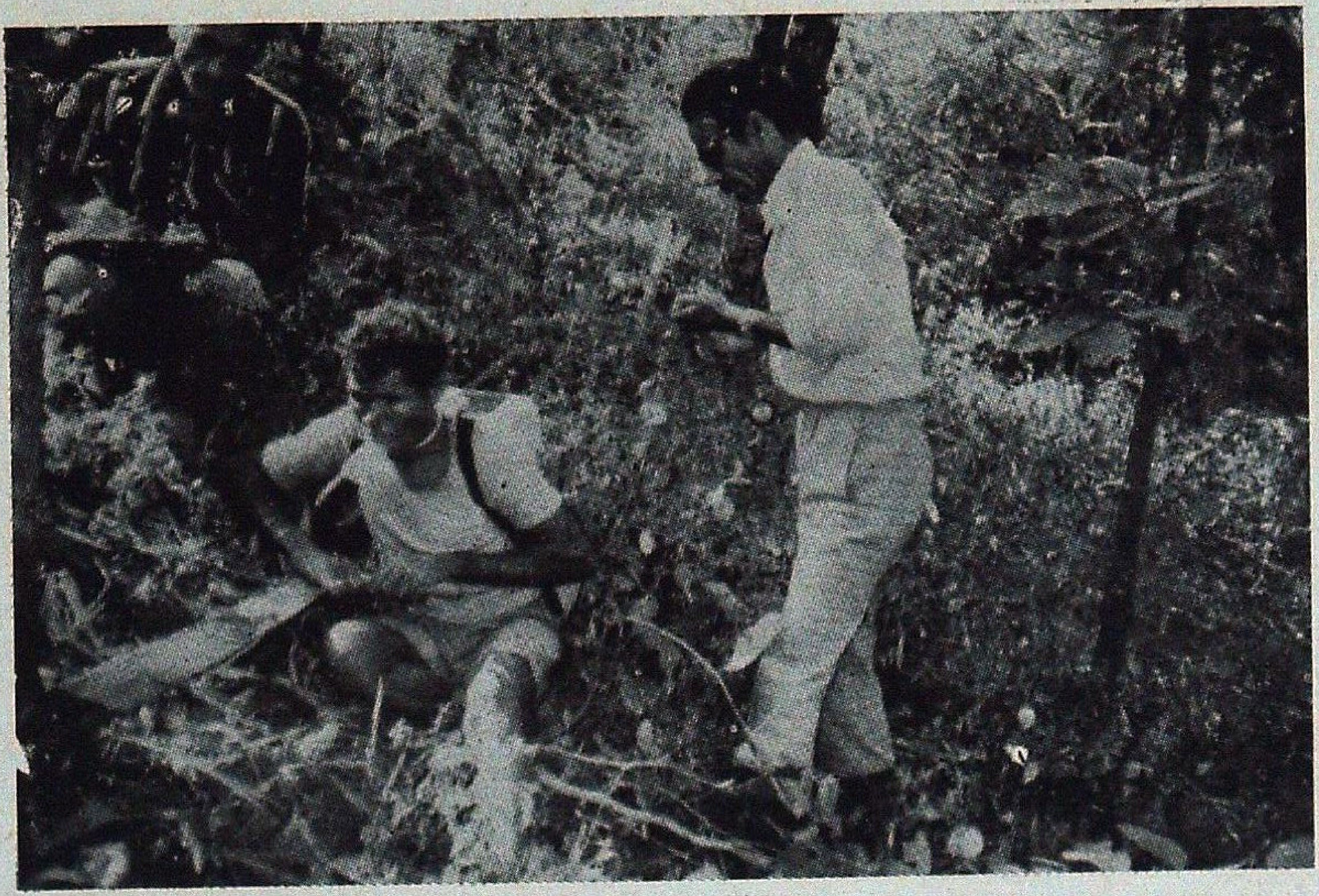
Results and Discussion

The physical characteristics and results of pulmonary function tests of the test subjects are given in Table 2.

The age of the subjects ranged from 21 to 40 years, which is considered the best and most common age for heavy works as logging. The body weight averaged only 44.2 kg. The physical built of forest workers in Central India is poor than the forest workers in mountain forests in the North. In another study conducted in North Bengal, the average body weight was found to be arround 60 kg. with higher aerobic capacity of the forest workers. The average maximal (or sub-maximal) oxygen uptake of the workers in Central India has been found 42.54 ± 4.87 ml/kg/min which is 18 per cent less than for workers in Noth Bengal and this is comparable to the difference in body weight. The highest aerobic power in the present case was recorded as 12.73 Kcal/min. and lowest 7.89 Kcal/min with average of 9.16 Kcal/min.

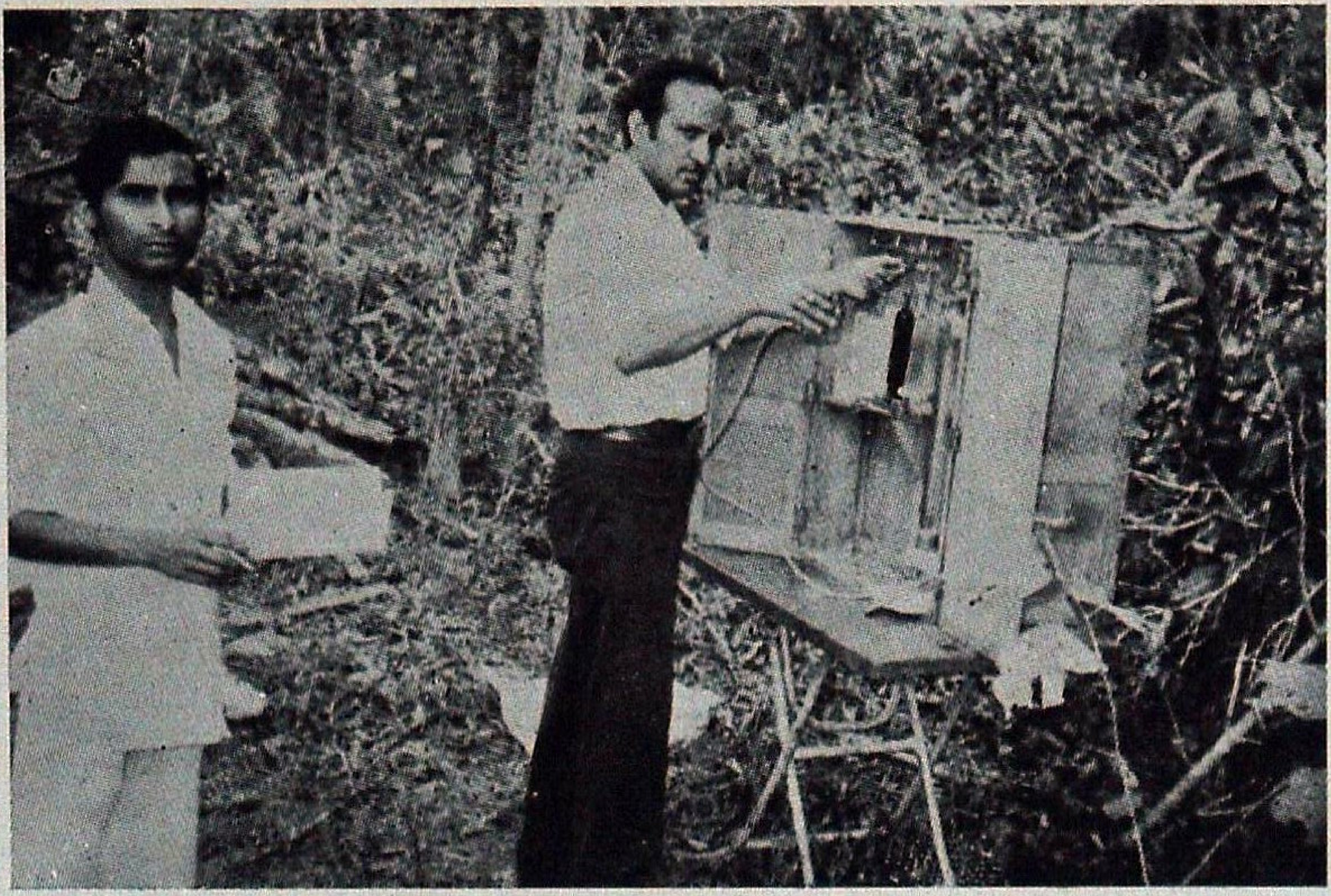
Physiological responses in cutting operations The field studies in this case were confined to felling and cross cutting operations by three different tools namely axe, two-man raker saw and peg-tooth saws. The pulmonary ventilations, energy expenditure, heart rate and relative workload as percentage of maximal oxygen uptake on these operations are given in Table 3.

Plate 5



Collection of exhaled gas sample on felling

Plate 6



Field analysis of gas sample by Orsat Gas Analyser

Table 2

Physical characteristics and aerobic power of forest workers.

Variables	Mean	± Standard deviation
Physical Characteristics		
1. Age (y)	26.90	6.36
2. Body height (cm)	158.80	6.03
3. Body weight (kg)	44.20	3.77
4. Resting pulse rate	83.60	8.07
Pulmonary function capacity		
1. Maximal observed workload kpm/min	990.00	77.46
2. Highest observed pulse rate/min	139.90	2.13
3. Pulmonary ventilation (Vol. of expired air) V_el/min	41.62	8.70
4. Maximal oxygen uptate Vo_2l/min.	1 87	0.18
5. Maximal oxygen uptake ml/kg/min.	42.54	4.87
6. Aerobic power Kcal/min.	9.16	1.53

Table 3

Physiological response of forest worker in tree felling and cross-cutting.

Operation/ Tool	Pulmonary ventilation l/min	Oxygen Uptake O_2l/min	Energy Expenditure Kcal/min.	Average pulse rate on work beats/min	Relative work-load per cent of Vo_2 Max
Felling					
Raker saw	28.04	1.00	4.63	115.20	55.12
	±5.09	±0.18	±0.67	±5.66	±9.06
Peg-tooth saw	33.67	1.19	5.47	112.82	65.88
	±3.89	±0.17	±0.88	±5.09	±10.64
Cross-cutting					
Raker saw	24.17	0.88	4.05	116.79	48.70
	±2.86	±0.14	±0.68	±9.67	±13.60
Peg-tooth saw	31.87	1.10	4.63	120.70	61.23
	±2.92	±0.23	±0.94	±2.85	±14.55
Axe cutting	34.30	1.69	7.99	120.65	92.94
	±3.73	±0.18	±0.83	±4.02	±3.59

The cutting operation by axe has been found most strenuous. The workload of axe work is very close to maximal aerobic capacity of the workers. The energy expenditure is as high as 7.99 Kcal/min, which is over 90% of the maximal power of the worker The use of axe in wood harvesting operation should therefore, be kept at minimum for the reason of high workload and work physiology point and with a view of avoiding wastage of wood in axe cutting. Tree felling operations by raker or peg-tooth saws exert higher workload than cross-cutting operation by the same implements. This is explained by uneasy and difficult working posture while felling the tree at a point close to ground level, as the worker has to bend sharply and also that the problem of saw pinching and friction on the kerf is much higher in tree felling than in cross-cutting. The workload and energy expenditure in working with raker saw is lower than with peg-tooth saw to the extent of 15% in felling and 12% in cross-cutting It has also been observed that unlike respiratory responses to workload, there was not much consistency in average pulse rate responses on work. The average work pulse rate ranged from 106 to 131 beats per minute in cutting works.

The physiological demands on wood cutting operations by manual saws varied from 48.70% with raker saw to 65.88% in peg-tooth saw, of the maximal oxygen uptake capacity. In activities requiring heavy manual efforts which is more than 50% of the maximal aerobic capacity, it is difficult to sustain the workload over longer period without affecting adversely the health of individual and also the rate of production. It is known that when a worker takes to manual work from a resting state, the physiological functions, as oxygen uptake and heart rate increase to a steady level after a few minutes of work at a given workload and continue at this level as long as the work load remain constant This means, the demand of O_2 for the work and its supply are balanced for the required energy yield. Over prolonged activity and inadequate O_2 supply, energy yield also takes place in muscular cells through anaerobic process, causing accumulation of waste products as lactic acid in blood which gives indication of fatigue. The accumulation of lactic acid in blood also causes additional load on cardiovascular system which is reflected by further increase in heart rate. Thus, during a constant work output for longer period, a gradual rise in heart rate takes place with the progress of work. The heart rate for the same workload is higher towards the end of the work day than in the beginning of the work activity. It is established that the allowable workload of workers for prolonged activity should be between 30% to 40% of individuals maximal aerobic capacity (Saha, *et al.* 1979). Heavy work activity as manual sawing and axe cutting in timber harvesting certainly extends over few man-hours each day for the loggers, as also shown in Table 4. Other logging operations as handling of logs, loading and unloading are also in no way light works. Thus, the logging workers are subjected to a very high physical hardship while working with conventions tools or axe and saw in cutting works and handling loads through direct physical force.

Energy need. Various jobs in timber harvesting operations can be categorised into light, moderate, heavy and extremely heavy jobs corresponding to relative workloads of upto 25%, above 25% to 50%, above 50% to 75% and beyond 75% of the maximal aerobic capacity of the workers as obtained from bicycle ergometer test.

Table 4

Workload categorisation of logging jobs.

Variables	Light	Moderate	Heavy	Extremely heavy
Vo_2 max (%)	Below 25%	Upto 50%	Upto 75%	Above 75%
O_2 Consumption in litres per minute	$\leqslant$0.467	0.468 to 0.935	0.936 to 1.403	$\geqslant$1.404
Energy cost Kcal/min	$\leqslant$2.29	2.30 to 4.58	4.59 to 6.87	$\geqslant$6.88
Man-hours (%) estimated in each category	25.3	34.1	28.2	12.4
Operations in each category of work during 6 hours field work.	Tool maintenance, walking on level grounds, rest periods during works.	Clearence for felling, brush wood cutting, removing small branches, walking on terrains with tools.	Felling and cross-cutting by 2-man cross-cut saws.	Use of axe in tree felling & cross. cutting, wedging on felling.

It was observed that the best average working hours of the workers extended over 355 minutes a day. The workers were mostly from local villages and they preferred walking to their work every day, covering upto 10 km distance from home to work site which took them upto two and half hours for to and fro journeys. The total daily energy expenditure, of the present group of workers has been calculated to be 2450 Kcal. It is significant to note that 53% of the daily energy cost was during six-hours working day; the time weighted average energy demand for the working hours was about 3.66 Kcal/min. (40% of the maximal oxygen uptake) with peak loads extending over two to three hours a day. The level of activity of the forest workers must be so adjusted that the physical demand on body is maintained with in moderate level and peak load durations are brought down to the minimum, not exceeding an hour a day. This is possible through technological developments in logging technique and improvements of working tools and equipments. The present group of logging workers may be capable of performing moderate level of activity for a longer duration than at present. There is also deficiency in calorie intake of the workers which adversley affects the efficiency and quality of work rendered by the workers and impairs their health. The recommended level of calorie need for the present group of workers having body weight 40 to 50 kg should be around 3000 Kcal for better performaneel evel and health.

Acknowledgement

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ANALYTICAL STUDY OF TEAK PROVENANCE TESTS IN NORTH RAIPUR DIVISION OF MADHYA PRADESH

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Introduction

To study the influence of the origin of teak seed on the development of resulting plants and crops, an All India Teak Seed Origin Co-operative Experiment was organized by the Central Silviculturist (now Director, Forestry Research) in the year 1930. In all, eleven teak provenances in thirteen different centres in India and Burma were tried. The investigation was sub-divided into a short term and a long term experiment. The object of the former was to examine the effect of seed origin on germination, seedlings and sapling stages while the later aimed at a comparative study of the post sapling stages The experiment plots were laid out in 1931.

The results of the short term part of the investigation were summarised in the reports to the 1934 and 1939 Silvicultural Conferences. Broadly speaking, the experiment indicated "the superiority of seed of local origin to those of others in the region of natural range of teak as far as the establishment and early development extending over a period of 5 to 8 years is concerned".

For investigating the long term objectives, sample plots were laid out in 1938/1939 in the resulting crops at various Centres. Mathauda (1954) has summarised the performance of various provenances in different Centres and has concluded that "......it is difficult to predict the behaviour of teak crops from different seed origins in any locality. The matter has to be investigated for each place independently. Also, as the comparative behaviour of crop from the same origin may vary with age, this investigation should be carried out over the full rotation. The experience so far gained indicates that, generally, in the region of natural range of teak, the local seed is likely to give good results, but may not prove to be the best. Of the imported seed, that from dry localities is not usually so good as that from the moister area".

One of the Centre for such investigations in is North Raipur Division of Madhya Pradesh. This paper deals with the quantitative and qualitative analysis of the growth performance of the resulting crop of different teak seed origins tried in this locality.

Site features of the Study Area

North Raipur Division lies between the parallels of latitudes 20°45′ and 21°45′ North and between the meridians of longitudes 81° 31′ and 83°15′ East. Its altitude varies from 255 metres to 741 metres above mean sea level An average annual rainfall is about 1350 mm, the bulk of which falls from June through September. The number of rainy days are about 80. Cold weather is mild and hot weather is severe. The maximum temperature goes upto 47°C. Frost is practically absent, underlying rocks are gneiss anc schist which are exposed at places. The soil is fairly deep, brown and red and varies from sandy loam to clayey loam.

According to Champion & Seth (1968), the forest type belongs to Northern dry mixed deciduous forest (5B/C2) with *Terminalia tomentosa, Anogeissus latifolia, Pterocarpus marsupium* and its associates.

Material

In 1931, teak seeds of following origin were received by the Silviculturist, Madhya Pradesh from the Central Silviculturist for raising plantations alongwith teak seeds of local origin under All India Teak Seeds Origin Co-operative Experiment.

Origin	Locality	Zone	Average annual rainfall (mm)
Burma	Myitkyna	L 24°N	2000
Kerala	Nilambur	Moist	2800
Madhya Pradesh	Betul	Dry	1240
Maharashtra	Kanara	Moist	2440
Karnataka	Kakankoti	Moist	1530

Due to the shortage of time, un-weathered seeds were sown in March/April and 'Dona' plants were prepared. When these plants were about 30 cms tall they were transplanted in pits of 15 cm diameter and 22 cms depth at an espacement of 2 metre × 2 metre in June/July 1931 in Compartment 309 of Kotbari R.F. block of Sonkhan range. About 0.809 ha ($\frac{1}{2}$ acre) of plantation of each seed origin was raised in two blocks, one where the underlying rock was gneiss and another where it was schist. Locally, they are popularly known as gneiss and schist plots (Lokre, 1959).

When these plantation were 7 years old, the Silviculturist of Madhya Pradesh laid out sample plots in both the blocks. Area of each sample plot is 0.1 ha Since there formation, all the twelve sample plots are being measured at about 5 years interval and uniform treatment of thinning has been applied. The growth data of these sample plots form the base material for the present study.

Objects of the Study

The main objects of the present study are :

(1) To investigate the differences in size, shape, germination and growth in early stages of various teak seed origins, and

(2) To analyse the growth performance of the resulting crops of various seed origin with a view to select the most suitable and adaptable provenance for the locality.

Method, Results and Discussion

The investigations on the size, weight, germination and plant per cent of different seed origins were carried out by the Forest Research Institute at Dehra Dun (Anon., 1934). The results pertaining to the various teak seed origin from which the plantation were raised in Madhya Pradesh Centre are given below :

Table 1

Showing the size, weight, germination and plant per cent of various provenances of teek seeds

Origin of seed	Average diam of seed (mm)	Average No. of seeds per kg.	Average germination (%)	Average plant (%)
N. Burma	15.7	1192	35	2 6
Nilambur	13.7	1700	34	11.2
Betul	11.4	2197	12	—
Maharashtra	11.2	2640	13	1.2
Karnataka (Kakankoti)	12.2	1898	46	20.5

It appears from the above table that the teak seeds from moist localities are comparatively heavier and bigger in dimension than those from the dry localities.

The survival per cent and average height of plantation of various teak seed origin were assessed in both the plots when they were 3 season old. The results are summarised below (Anon, 1934).

Table 2

Showing the survival per cent and Average height of plantation of various seed origin after 3 season growth

Seed origin	Schist		Gneiss	
	Survival (%)	Average height (m)	Survival (%)	Average height (m)
Burma	98	2.9	100	3.9
Nilambur	99	5.5	97	5 8
Betul	96	1.8	99	3.8
Maharashtra	99	3.3	99	4.1
Karnataka	98	5.2	99	5.8

It is evident from above that as far as the height growth in concerned, Nilambur Seed origin has given the best results and the second best is from seed origin of Karnataka. The survival percentage ranges from 97 to 100.

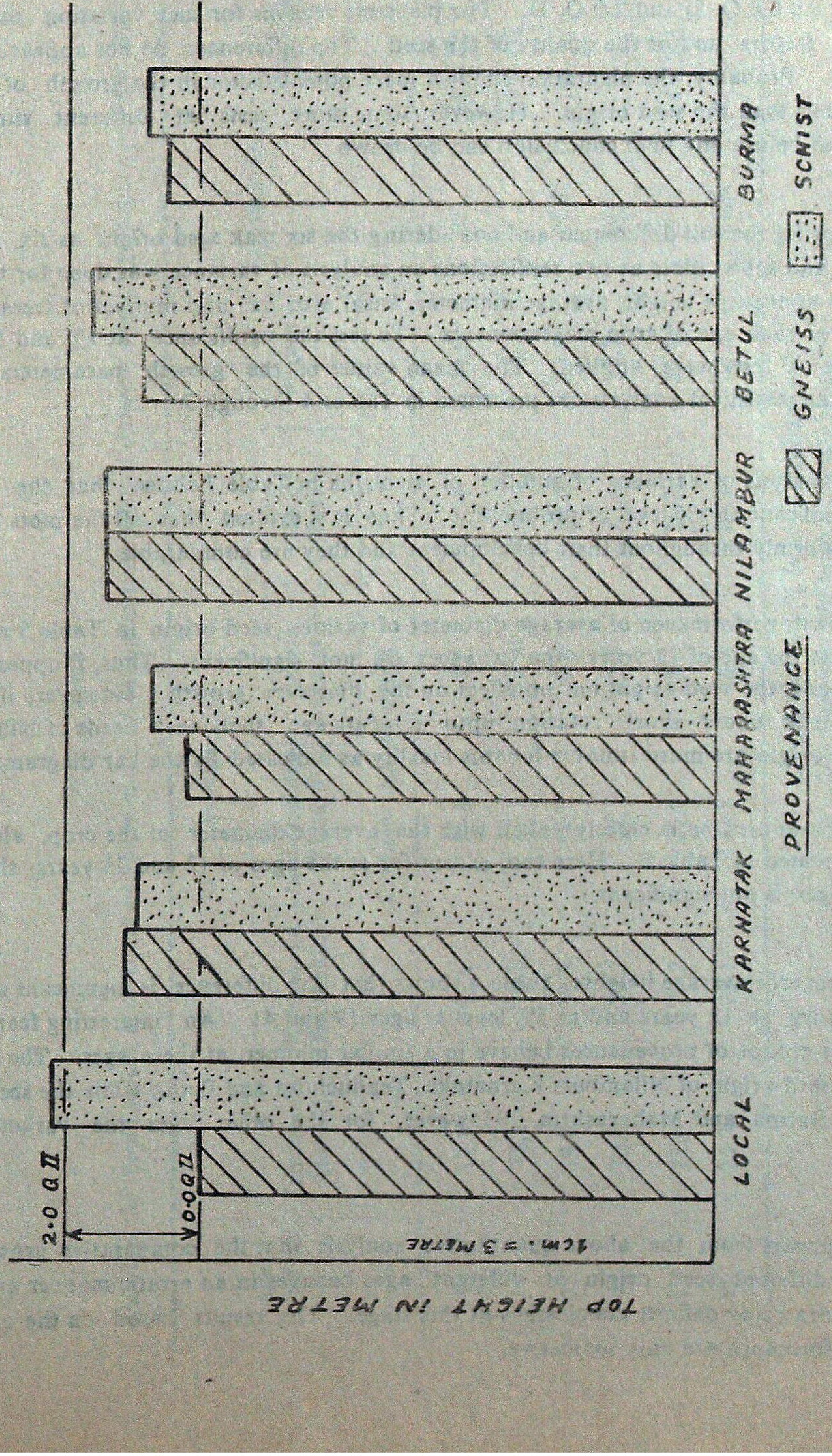
Top height is usually considered as an index of the site quality. Thus, to determine the average site quality of various sample plots, the top heights were computed at different ages and compared with the plantation yield tables (Anon. 1957) Table 3 gives the average site qualities of different sample plots while Fig. 1 shows the histogram of site qualities at the age of 47 years.

Table 3

Showing the All India Site Qualities of Teak seed origin plots in North Raipur Division of M.P.

Seed origin	Fractional site quality	
	Gneiss	Schist
Local (Tendnchua)	0.0 Q. II	2.0 Q. II
Karnataka	1.0 Q. II	1.0 Q. II
Maharashtra	0.0 Q. II	1.0 Q. II
Nilambur	2.0 Q. II	2.0 Q. II
Betul	1.0 Q. II	2.0 Q. II
Burma	1.0 Q. II	1.0 Q. II

Fig. 1



Comparative top heights of different Teak Provenances at 47 years in N. Raipur Division (M.P.)

Scrutiny of Table 3 and Fig. 1 reveals that the site qualities of different sample plots range between 0.0 Q. II and 2.0 Q. II. The plausible reasons for such variation may be the micro site factors and/or the quality of the seed. The differences do not appear due to the seed origin. Probably, the plantation site is a more potent factor in the growth of dominant heights rather than the seed origin. However, some more tests at different site qualities are essential before any final conclusion can be drawn.

Ignoring the soil differences and considering the six teak seed origin as six treatments and gneiss and schist plots as two replications an analysis of variance was done for the growth parameters of average height, average diameter, basal area/ha and number of trees/ha of the main crop at each age of crop measurements. To test the significance at 1% and 5% level of probability. F tests were applied. The mean values of the growth parameters and the results of the statistical analysis are presented in Tables 4 through 7.

An analysis of variance of number of stems/ha in Table 7 shows that the differences are not significant at 5% level of probability. Thus it is evident that all the plots have been thinned uniformly throughout their development and they are comparable.

Growth performance of average diameter of various seed origin in Table 5 reveals that except for at the age of 12 years, the variances are not significant. Thus, it appears that for long rotations, the seed origin has no effect on the diameter growth. However, if the object is to grow teak under short rotation upto 12 years age, then teak seeds of Nilambur and Karnataka origin are more suitable for this locality as indicated by the bar diagram.

As basal area/ha is closely linked with the average diameter of the crop, almost same trend is repeated in Table 6. Here too, except for at the ages of 12 and 25 years, the variance for other ages is not significant.

As regards average heights, Table 4 shows that the difference is significant at 1% level of probability at 12 years and at 5% level at ages 19 and 41. An interesting feature is that two distinct groups of provenances behave in a similar manner at these ages. The first group consists of seed origin of Nilambur, Karnataka, Tenduchura and Betul, while the second group constitute Burma and Maharashtra. However, for the other ages the variance is not significant.

It appears from the above quantitative analysis that the comparative growth performance of different seed origin at different ages behaves in an erratic manner and it is not feasible to draw any definite conclusions at this stage. The results based on the quantitative growth performance are only indicative.

Table 4

Showing the mean values of Average height in metre of various provenances at different ages, Significance and Bar diagram.

Age (years)	Provenances						Significance	Bar diagram
	Tenduchua (Local)	Karnataka (Kakankoti)	Maharashtra (Kanara)	Kerala (Nilambur)	M.P. (Betul)	Burma		
	Average height (metre)							
12	12.9	12.9	11.3	14.6	12.8	11.9	**	$\overline{4\ 2\ 1\ 5}\quad\overline{6\ 3}$
19	18.1	17.8	17.1	19.5	18.1	16.3	*	$\overline{4\ 5\ 1\ 2}\quad\overline{3\ 6}$
25	19.8	19.8	19.1	20.6	20.0	20.0	N.S.	—
36	22.7	22.7	22.1	23.5	23.6	20.7	N.S.	—
41	23.6	24.2	23.0	25.0	24.2	20.4	*	$\overline{4\ 2\ 5\ 1}\quad\overline{3\ 6}$
47	25.3	25.1	24.8	26.8	25.9	22.9	N.S.	— —

** Significant at 1 % level of probability

* Significant at 5% level of probability

N.S. Not Significant

Table 5

Showing the mean values of Average diameter in cms of various provenances at different ages, significance and Bar diagram

Age (years)	Provenances						Significance	Bar diagram
	Tenduchua (Local)	Karnataka (Kakankoti)	Maharashtra (Kanara)	Kerala (Nilambur)	M P. (Betul)	Burma		
	Average diametere (cms.)							
12	12.1	12.6	11.4	14.2	11.4	12.2	**	$\overline{4\ 2}\quad\overline{3\ 5\ 1\ 6}$
19	16.5	18.0	18.3	19.3	16.9	17.4	N.S.	
25	19.2	21.6	18.9	22.0	19.8	19.3	N.S.	
31	21.2	23.9	20.8	24.3	22.2	21.3	N.S.	
36	23.6	26.4	23.0	25.9	24.2	24.0	N S.	
41	25.1	28.4	24.2	27.3	26.0	25.1	N.S.	
47	28.6	31.5	27.3	30.2	29.2	28.1	N.S.	

** Significant at 1% level of probability

N.S. Not Significant of 5% level of probability

Table 6

Showing the mean values of Basal area/ha in m² of various provenances at different ages, significance and Bar diagram

Age (years)	Provenances						Significance	Bar diagram
	Tenduchua (Local)	Karnataka (Kakankoti)	Maharashtra (Kanara)	Kerala (Nilambur)	M.P. (Betul)	Burma		
	Basal area/ha (m²)							
	ages, Significance and Bar diagram							
12	9.348	9.853	8.488	11.825	8.740	8.946	**	$\overline{4\ 2}$ $\overline{1\ 6\ 5\ 3}$
19	10.277	10.025	9.738	11.114	10.633	10.678	N.S.	
25	11.137	11 332	10.575	11.137	10.931	12.846	**	$\overline{6\ 2}$ $\overline{1\ 4\ 5\ 3}$
31	13.397	13.521	13.500	13.229	13.833	13.638	N.S.	
36	12.686	13.638	12 582	13.534	12.559	13.007	N S.	
41	18 558	14.922	13 775	14.773	14.211	14.246	N.S.	
47	18.168	18.386	17.870	18 237	17.297	17.721	N.S.	

** Significant at 1% level of probability.

N.S. Not Significant at 5% level of probability.

Table 7

Showing the mean values of Number of Stems/ha of various provenances at different ages, significance and Bar diagram

Age (years)	Provenance						Significance	Bar diagram
	Tenduchua (Local)	Karnataka (Kakankoti)	Maharashtra (Kanara)	Kerala (Nilambur)	Madhya Pradesh (Betul)	Burma		
	(Number of stems/ha)							
12	822	883	835	737	841	764	N.S.	
19	483	409	484	389	479	449	N.S.	
25	388	314	386	299	354	440	N.S.	
31	378	309	386	289	354	380	N.S.	
36	289	249	309	259	272	286	N.S.	
41	284	235	300	252	267	286	N.S.	
47	284	235	300	252	267	286	N.S.	

N.S. Not significant at 5% level of probability

In the case of timber trees grown for the production of saw logs, apart from the quantitative growth, the qualitative characteristics, such as soundness, straightness, cylindrical and clean bole, knots, forking, branchiness, malformation and diseases are very important as these characters determine the value of timber. In the case of provenance tests, the qualitative considerations become more important because the objectives are to select the provenance which produces quality timber trees of maximum value.

As the occular method of assessing the qualitative growth may lead to bias and thus wrong conclusions, an attempt was made to quantify the qualitative growth performance. For this purpose, each stem in each sample plot on gneiss block was examined and graded. Following five grades were recognized and considering the quality of stems, the appropriate numerical unit value was assigned to each grade.

Table 8

Showing the qualitative grades of stems with their unit values.

Grade		Numerical unit value
I	Sound, healthy and straight	5
II	Sound and healthy but with double leader or forked	4
III	Malformed (knothy, branchy)	3
IV	Unhealthy (dead, dying and diseased)	2
V	Other prominent defects such as water blisters etc.	1

After grading, the percentage of stems in each grade was calculated and the total unit values computed for each seed origin. The data is presented in Table 9.

A casual glance on Table 9 will show that there is wide variation in the score of unit values of different seed origins. Maximum score is obtained by the seed of Nilambur origin with 433.4 points and the lowest by that of Burma origin with 273.3 only. Thus the grading of growth performance on qualitative consideration is in the following order.

1. Nilambur
2. Betul
3. Tenduchua
4. Maharashtra
5. Karnataka
6. Burma

Table 9

Showing the percentage distribution of stems in five grades along with the score of unit values of teak seed origin plot in North Raipur Division (M.P.)

Grades	Seed origin											
	Tenduchua (Local)		Karnataka (Kakankoti)		Maharashtra (Kanara)		Kerala (Nilambur)		Madhya Pradesh (Betul)		Burma	
	No. of stems (%)	Unit value	No. of stems (%)	Unit value	No. of stems (%)	Unit value	No. of stems (%)	Unit value	No of stems (%)	Unit value	No. of stems (%)	Unit value
I	19.4	97	—	0	11.5	57.5	6.25	312.5	25.0	125	6.9	34.5
II	29.0	116	16.7	66.8	34.6	138.4	16.7	66.8	39.3	157.2	17.2	68.8
III	41.9	125.7	79.2	237.6	34.6	103.8	12.5	37.5	28.6	85.8	20.7	62.1
IV	9.7	19.4	4.1	8.2	19.3	38.6	8.3	16.6	7.1	14.2	51.7	103.4
V	—	—	—	—	—	—	—	—	—	—	3.5	3.5
Total	100	358.1	100	312.6	100	338.3	100	433.4	100	382.2	100	272.3
Ranking		Third		Fifth		Fourth		First		Second		Sixth

Summing up

This experiment was laid out about half a century ago when the principles of statistics and genetics were in the initial stages of development. Thus, it is but natural that some short comings are likely to creep into the lay out and conduction of the experiment, such as randomization, number of replications and thinning etc. Moreover, such types of experiments in forestry are of very long durations and, therefore, it is rather difficult, if not impossible, to maintain the continuity and precesion aimed at the commencement of the experiment. Thus, within these limitations and constraints the results of the present study indicate that :

(1) The teak seed from moist locality is bigger in size and weight as compared to that from the dry zone.

(2) The germination and plant per cent appear to depend on the quality of the seed rather than on its size and weight.

(3) The top height appears to be a function of site quality rather than that of seed origin.

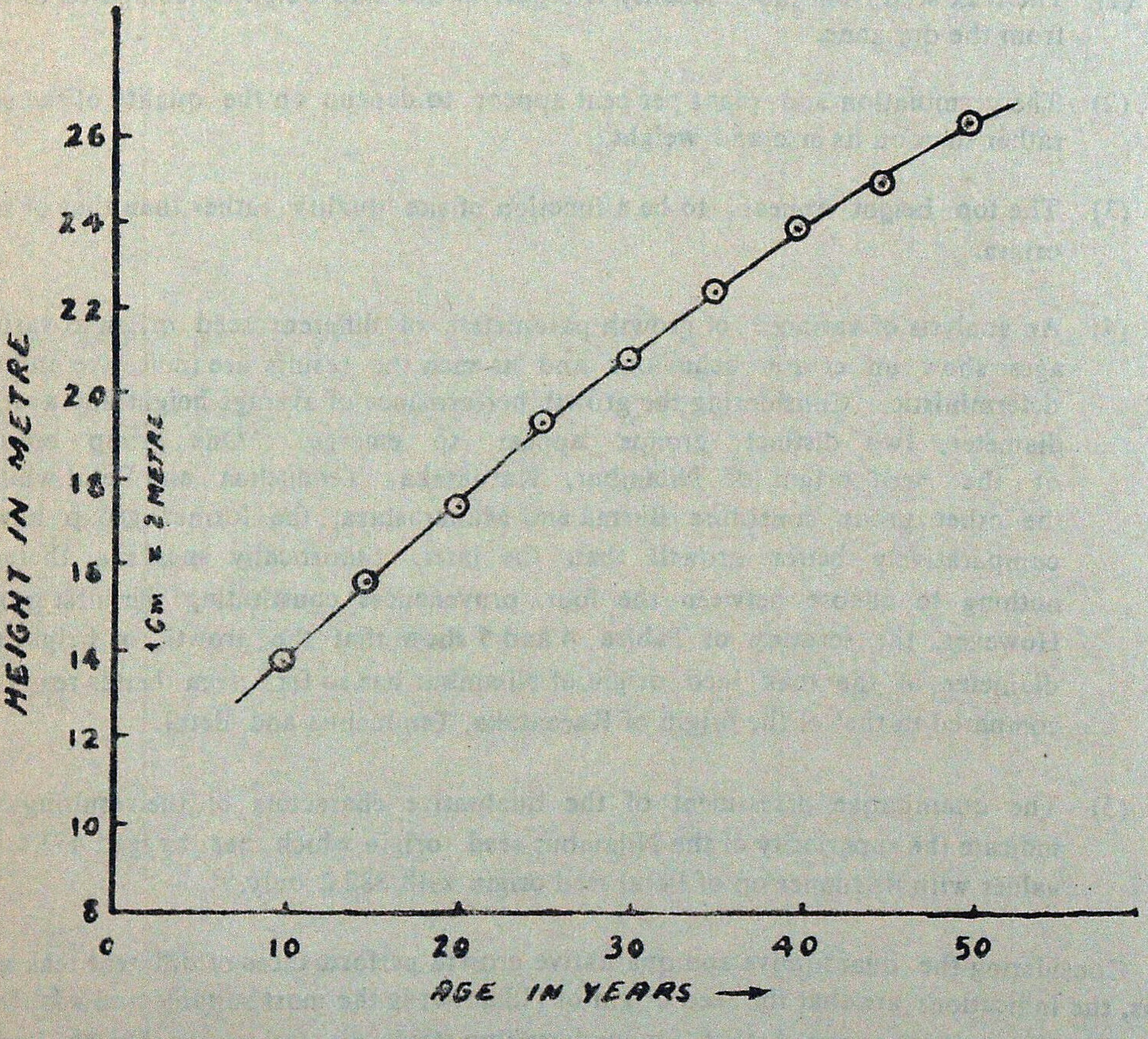
(4) An analysis of variance of growth parameters of different seed origin at various ages show an erratic behaviour and as such the results are indicative and not deterministic. Considering the growth performance of average height and average diameter, two distinct groups appear to emerge. One group consists of the seed origin of Nilambur, Karnataka, Tenduchua and Betul while a the other group constitute Burma and Maharashtra, the former group having comparatively better growth than the later. Statistically speaking there is nothing to choose between the four provenances constituting the first group. However, the scrutiny of Tables 4 and 5 show that the growth of height and diameter of the teak seed origin of Nilambur has so far given better results as compared to that of the origin of Karnataka, Tenduchua and Betul.

(5) The quantitative assessment of the qualitative characters of the resulting crop indicate the superiority of the Nilambur seed origin which has bagged 433.4 unit values with its runner up of Betul seed origin with 382.2 only.

Considering the quantitative and qualitative growth performances of different teak seed origins, the indications are that the seed origin of Nilambur is the most suitable and adaptable in this tract. Thus, it is suggested that for undertaking teak plantations in North Raipur Division, the seeds of Nilambur provenance be used.

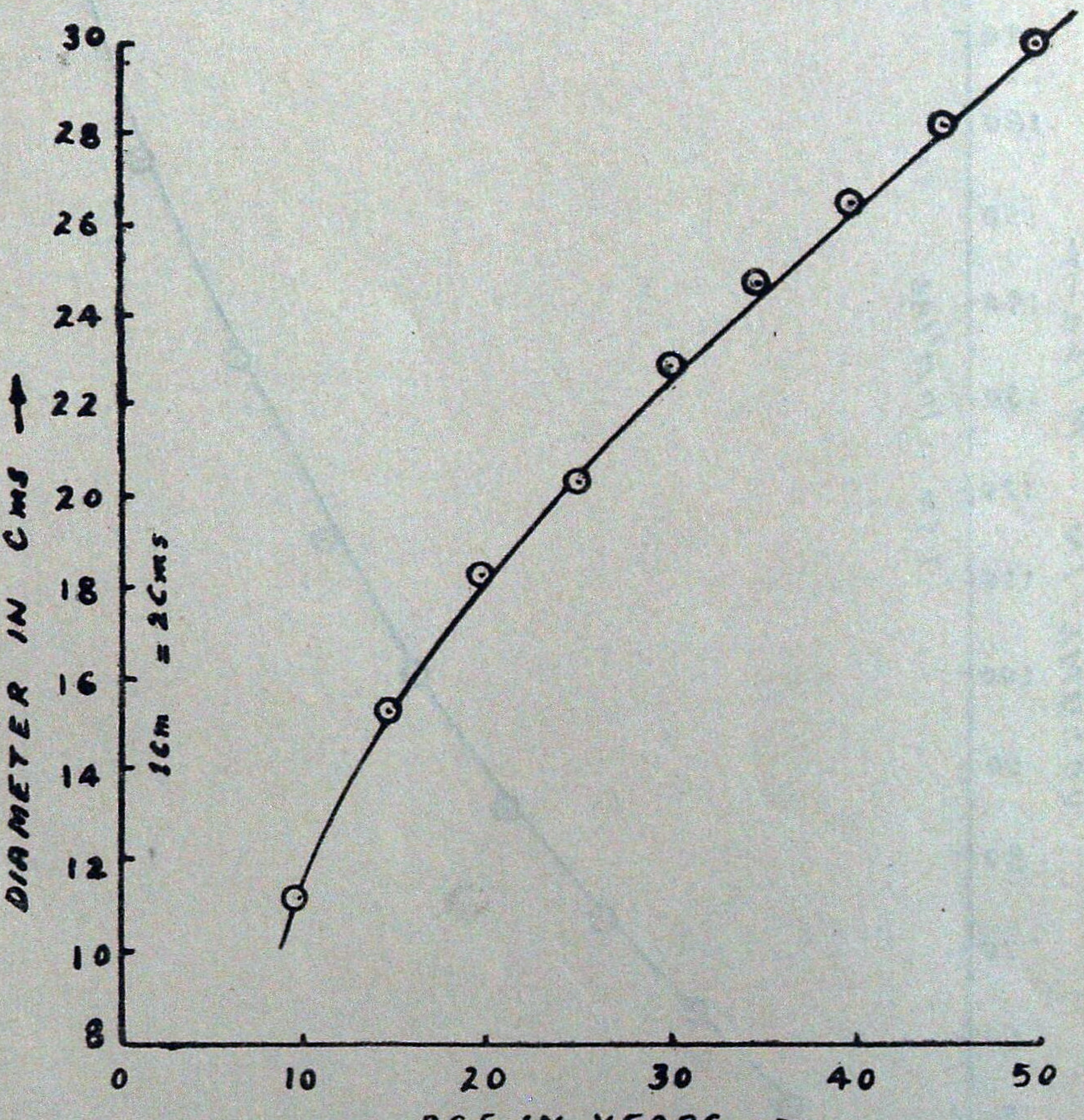
Based on the sample plot measurements, the growth data of Nilambur seed origin was plotted on the graph paper and smooth curves were drawn. Figures 2 through 4 give the growth curves for height, diameter and volume/ha of the main crop whereas Table 10 presents

Fig. 2



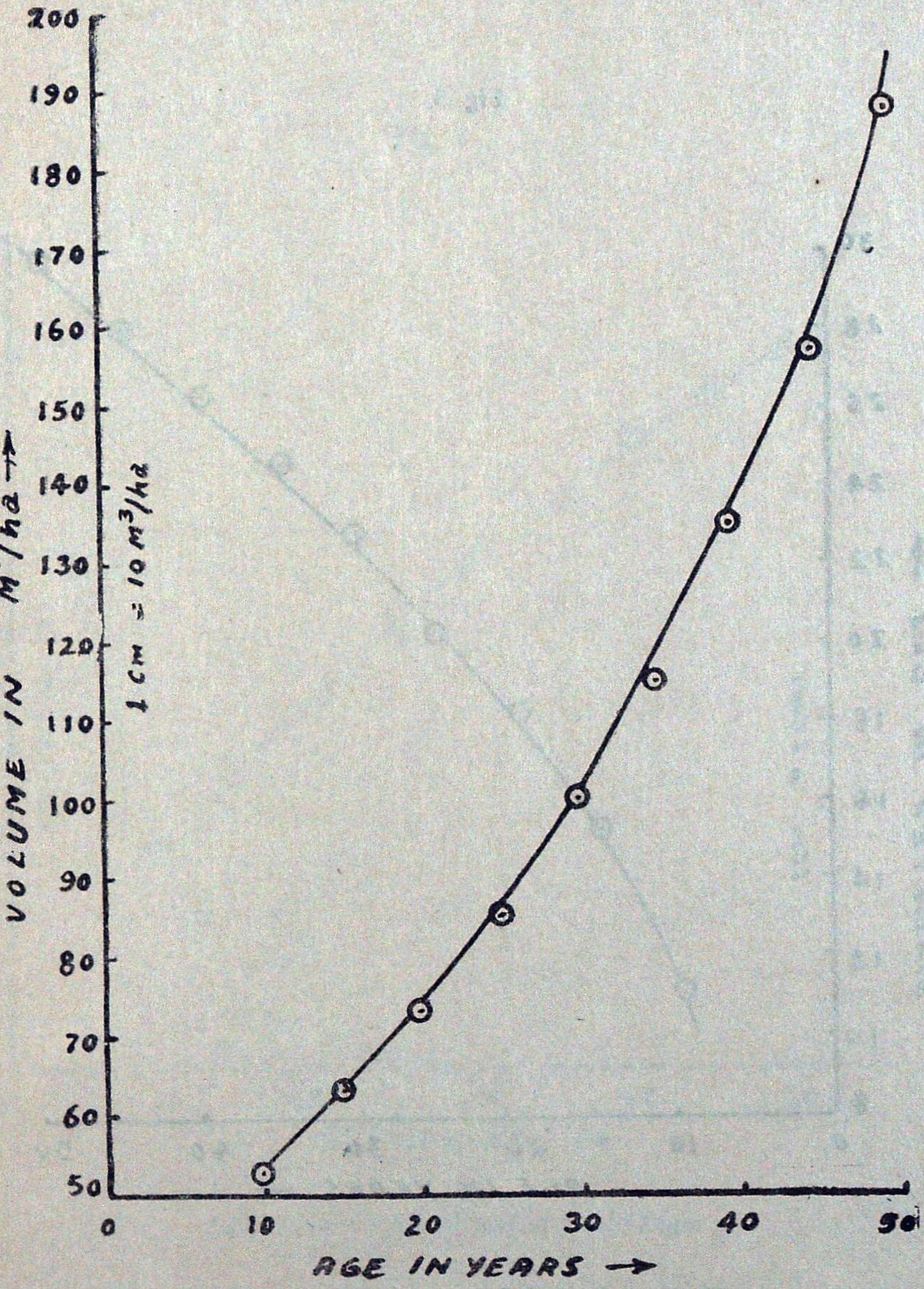
Age/Height Curve-Nilambur Seed Origin

Fig. 3



Nilambur Seed Origin Age/Diameter Curve

Fig. 4



Nilambur Seed Origin Age/Volume Curve (Main Crop)

Table 10

Showing the growth of Nilambur Teak seed origin plantation in North Raipur Division (Madhya Pradesh) for the main crop

Age (years)	Top height (m)	Average diameter (cm)	Average height (m)	Basal are per ha (m²)	No. of trees per ha	Form factor		Volume per ha of standing crop (m³/ha.)		
						Stem timber	Small wood	Stem timber	Small wood	Total vol. stem timber and small wood
10	14.0	11.2	13 5	9.250	770	0	0.415	0	51.823	51.823
15	16.7	15.2	15.5	9.500	525	0.020	0.405	2.945	59.634	62.579
20	18.7	18.2	17.2	9 875	425	0.055	0 370	9.342	62.844	72.186
25	20.7	20.2	19.2	10.375	380	0 095	0 350	18.924	65 736	84.660
30	22.2	22 7	20.7	11.375	345	0.150	0.275	35.319	64.752	100 071
35	23.7	24.5	22.2	12.375	330	0 200	0.215	54 945	59.066	114.011
40	25.0	26.2	23.5	14 125	315	0.250	0.155	82.984	51.450	134.434
45	26 2	28.0	24.7	16.000	300	0.280	0.115	110.656	45.448	156.104
50	27.2	29.7	26.0	18.625	290	0 300	0.085	145.275	41.161	185 436

the growth statistics of the Nilambur seed origin for the study area. The general crop description of Nilambur seed origin plantation as observed in 1978 by the author may be described as follows :

"The crop is uniform, both in size and density. Almost all the stems are well formed, fairly straight and almost free from epicormic branches. Its crown is well formed, small and confined to the upper one fourth of the tree".

Acknowledgement

Author is grateful to the officers of the Statistical Branch of the Forest Research Institute, Dehra Dun for the statistical analysis of the data.

SUMMARY

Forest tree improvement programmes start with the study of available variation in the entire range of species distribution and delimitation of population capable of providing the best tree This is done by the provenance tests. In North Raipur Division of Madhya Pradesh, teak plantations were raised from the seeds obtained from Maharashtra (Kanara origin), Burma Kerala (Nilambur), Madhya Pradesh (Betul and Tenduchua) and Karnataka (Kakankoti) and sample plots were laid out in 1938 as a part of the All India Teak Seed Origin Co-operative Experiment. Quantitative and qualitative analysis of the growth performances of these provenances has been presented in this paper The indication are that teak seed origin of Nilambur is the most suitable and adaptable in this tract.

मध्यप्रदेश में उत्तरी रायपुर वन मंडल में सागौन के क्षेत्रज परीक्षणों का विश्लेषणात्मक अध्ययन

लेखक एस० के सूरी

सारांश

वन वृक्षों के परिष्कार का कार्यक्रम किसी वृक्ष जाति के संपूर्ण विस्तार क्षेत्र में मिलने वाले उसके विभिन्न विभेदों का अध्ययन करने तथा उनमें से सर्वोतम वृक्ष दे सकने वाले समुदाय को परिसीमित करने पर आरंभ होता है। यह कार्य क्षेत्रज [प्रोवीनेंस] परीक्षणों द्वारा किया जाता है। मध्यप्रदेश के उत्तरी रायपुर वन मण्डल में सागौन के रोपवन महाराष्ट्र (कनारा उद्गम) ब्रह्मा, केरल (नीलाम्बुर), मध्य प्रदेश (बैतूल और तेंदुचुआ) और कर्णाटक (काकनकोटि) से मंगाए बीजों से लगाए गए तथा उनके नमूना क्षेत्र 1978 में अखिल भारतीय बीजोंद्गम सहकारी संपरीक्षण के अंग स्वरूप बनाए गये। इन क्षेत्रों की वृद्धि सक्रियता के मात्रात्मक और गुणात्मक विश्लेषण का परिणाम इस अभिपत्र में प्रस्तुत किया गया है। इनसे पता लगता है कि इस भूक्षेत्र में लगाने के लिए नीलाम्बुर उद्गम के सागौन का बीज सबसे अधिक उपयुक्त और अपनाने योग्य है।

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FIREWOOD CROPS IN AREAS OF BRACKISH WATER

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Parts of Mathura, Agra, Etah and Aligarh districts have special problem of brackish water. This water has electronic conductivity (E/C) of over 4. Analysis of water at 4 samples indicated that pH ranges from 7.00 to 7.85 and E/C from 4.00 to 6.10. Detailed analysis of a sample of water of the Forest Research Station, Mathura indicated following values :

Total Soluble salts	0.235 gm%
Carbonate	0.8 me/lit
Bicarbonate	52 me/lit
Chloride	1.57 gm/lit
Sodium	35.65 me/lit
Potassium	0.24 me/lit
Calcium	2.6 me/lit
Magnesium	29.4 me/lit
SAR	8.913 me/lit
ESP	10.62
pH	7.58
EC	4.67

This water can be cured by the process of reverse osmosis but the cost of the process is high. The water is toxic to several crops and irrigation of plants with the water may retard their growth and may even kill some of them. Treatment of the water for irrigation to remove salts will be uneconomic.

The water in this tract has developed brackishness due to the destruction of vegetation during a period of several centuries. The destruction of natural vegetation has been almost complete and there is no natural forest left now. In normal course trees and shrubs would have absorbed the salts from this water and kept them at low concentration but due to lack of vegetation the water evaporates leaving behind salts in increasing concentration. History of the old wells in this region shows that several wells which had sweet water considered good for drinking is now unfit even for irrigation. A beautiful flower garden, of Shri Rangji temple at Vrindavan has now dried up due to the deterioration of the quality of water from the nursery which provided irrigation to this garden for over fifty years.

The only economic method to check the deterioration of the quality of this water, is to search for those trees and shrubs which will tolerate this water and to raise them in sufficient numbers so that excess salts are absorbed and the quality of water is maintained and simultaneously enough firewood is produced to meet the local demand.

With the above object in view a research station over 12 hectares of land was started by the Research Wing of the State Forest Department 5 kms from Mathura-Vrindavan road during 1981. The soils in the area are largely clayey with a top layer of desert sand that has drifted during dust storms blowing from Rajasthan and settling in those areas.

Twenty species of trees and shrubs were planted during 1981 and 1982. The species have been planted in plots of 30 m × 30 m at a uniform spacing of 1.5 m × 1.5 m. There are three replications of each species. The species tried are :

Acacia auriculaeformis

Acacia nilotica

Adhatoda vasica–shrub

Albizzia lebbek

Albizzia procera

Azadirachta indica

Cassia auriculata–shrub

Cassia fistula

Cassia siamea

Cordia dichotoma

Dalbergia sissoo

Eucalyptus hybrid

Haplophragma adenophyllum

Leucaena leucocephala

Pongamia pinnata

Prosopis juliflora

Syzygium cumini

Tamarindus indica

Tamarix aphylla

Terminalia arjuna

Though the trials are only about 18 months old, they have given a clear indication about the species that should be planted here to supply the much needed fire wood. The species growing well are; *Prosopis juliflora*, *Acacia nilotica*, *Terminalia arjuna*, *Syzygium cumini*, *Albizzia lebbek*, *Pongamia pinnata*, *Cassia auriculata*, *Adhatoda vasica*, *Cassia siamea*.

Many farmers are planting *Eucalyptus hybrid* in this area as commercial tree farming. The species grows fast in the first year as long as the roots are confined to the top layer of sandy soil. It stagnates as it reaches the clay layers. Expected returns will not be obtained by planting *Eucalyptus hybrid*. *Su-babul* planted in this has become diseased and should generally be considered as a failure. Planting of Babul. *Prosopis juliflora*, *Arjun*, *Kanji*, *Cassia*, *Jamun*, *Siris*, and even shrub like *Cassia auriculata* are better commercial propositions.

Plantation of these species on farmland will cost about Rs. 4000.00 per hectare. These will give about 20 tonnes of firewood in five years. The present day cost of firewood is about Rs. 4000 per tonnes. The final income will be about Rs. 8,000/- per hectare. Thus an investment of Rs. 4000/- will be doubled in a period of five years giving an internal rate of return of 15%. This excludes the lops and tops and small firewood below 5 cms which will be available for internal use free of cost.

The planting of forest trees will improve the porosity and the productivity of the soil. It will improve the quality of water of the neighbouring wells and will in general have a beneficial effect over the adjoining cultivated lands.

SCRUB FOREST STUDIES—FOLIAR AND SOIL NUTRIENT STATUS OF *PROSOPIS JULIFLORA* DC.

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Introduction

In recent years, attention has been given to the effect of concentration of cations in soil and those taken up by the plant. Such information is not much available for the phanerophytes of the arid regions. The aim of this paper is to provide information about the nutrient content of the habitat in the scrub forest of the Thar desert of India, the nutrient content of the leaves of one of the dominant trees, namely, *Prosopis juliflora* DC., and correlation, if any between the foliar and soil nutrients. The author (1966 a, b, 1969) has earlier reported work of similar nature on some other common plants of scrub forest.

Prosopis juliflora is an evergreen tree, native of the arid regions of West Indies, Central America and Mexico (Duthie, 1960). It was introduced in the arid regions of India in the last century and has thrived well. It has covered vast areas of the sandy desert of Jodhpur and Bikaner Divisions of the Rajasthan State of India. This investigation was conducted around Churu town (27°5′ to 29°N latitude and 73°5′ to 75°5′ E longitude) lying in the North-East portion of Bikaner Division. There is a vast expanse of sand all around the town with accumulation at several places leading to the formation of dunes.

The climate of the area is characterized by frequent drought and extremes of temperature. The rainfall is scanty and irregular. It is mainly received during the monsoon season (July to September). Wind velocity is quite high during the summers and sand storms are a common feature of the area.

Methods of Study

Soil pits 75 cm deep were dug near the plant at five sites and soil samples were collected from 0–10 cm, 15–25 cm, 30–40 cm, 45–55 cm and 60-70 cm depth from the exposed profiles. Composite samples of each depth were air-dried and analysed for exchangeable calcium, magnesium, potassium and sodium, available phosphorus, total nitrogen, carbonates and organic carbon. pH was determined in 1 : 2 soil-water suspension for fresh samples with the help of Cambridge pH meter. Soil colour was recorded by Munsell soil colour charts. Klett Summerson photoelectric colorimeter was used to determine available phosphorus.

Leaf samples were collected at the same time as the soil. The plants were not in the flowering condition at the time of collection. They were dried, powdered and ashed for analysis of calcium, magnesium, potassium, sodium, nitrogen and phosphorus. Analysis of the samples was done by the methods suggested by Piper (1944).

Results and Discussion

(a) *Soil Studies.* Table 1 and 2 give details of certain properties of soils supporting *Prosopis juliflora.* The soils are mainly yellowish brown and light yellowish brown. The deeper samples were brownish yellow in a few profiles. The soils are coarse, sandy and alkaline (pH 7.0 to 7.9), There is little organic carbon in the soils supporting the plant. It is due to a sparse vegetation cover. Table 2 shows the average values of cations depth-wise and sitewise. The concentration of calcium, magnesium potassium and carbonates differed with depth but those of sodium and phosphorus did not. Calcium and carbonates tended to increase with depth while magnesium showed a decrease. Carbonates are quite soluble and leaching and subsequent accumulation in lower horizons is understandable. Infact the process leads to a leaching gradient. Several workers (Willis *et al,* 1959; Chandapillai, 1970; and Pemadasa *et al,* 1974) have also appreciated the occurrence of leaching gradients in dune habitats.

Gupta (1958) has reported percentage of carbonates as 0.0132 from sandy areas of certain places in the Bikaner Division while Joshi (1958) on the basis of qualitative analysis of Pilani soils has shown carbonate content as nil in sandy plain areas and meagre in the stabilized dune areas. Bharucha (1960) reported the value of carbonates in desert soils as 1 to 3 per cent. Shankarnarayana *et al* (1965) and Ghosh (1952) have reported carbonate values as 0.1 to 4.2 per cent and 1.13 to 7 63 per cent respectively. My results tally with the later workers and the range of carbonates was 0.5 to 3.5 per cent. However, the author (1968) had earlier reported the range as 0.5 to 7.5 per cent under certain plant communities.

The amount of soluble and exchangeable calcium in the soil decreased as the per cent exchangeable sodium in the soil increased (Pearson and Bernstein, 1958). The same was noted in this study with very few exceptions. It is an indication of the salinity problem in the area. There are several reports of widespread and extensive salinity in the Rajasthan desert.

The role played by calcium carbonate in the replacement of adsorbed sodium is exceptionally important in arid and semi-arid regions because it has a direct bearing on the productive condition of the soil. Kelley (1962) holds that both scientific experimentation and much practical experience have demonstrated that adsorbed sodium can be effectivelly replaced by calcium originating from calcium cabonate and that the application of calcium cabonate in some form has been found to be an effective means of removing adsorbed sodium and thereby converting the soil into a productive state.

Table 1

Soil features of Prosopis juliflora DC. in the Thar Desert of India.

Habitat	Soil character	Surface	Soil depth			
			15 cm	30 cm	45 cm	60 cm
Sandy Plain	Colour	*10 YR 6/4	10 YR 6/4	10 YR 6/5	10 YR 6/5	10 YR 5/6
	pH	7.8	7.8	7.9	7.9	7.9
	Org. Carbon %	0.5				
Sandy Plain	Colour	10 YR 5/4	10 YR 5/4	10 YR 5/6	10 YR 5/6	10 YR 6/6
	pH	7.1	7.1	7.2	7.3	7.4
	Org. Carbon %	0.39				
Sandy Plain	Colour	10 YR 6/4	10 YR 6/4	10 YR 5/6	10 YR 5/6	10 YR 5/6
	pH	7.0	7.1	7.2	7.2	7.3
	Org. Carbon %	0 28				
Sandy Plain	Colour	10 YR 6/4	10 YR 5/6	10 YR 5/6	10 YR 6/6	10 YR 6/6
	pH	7.1	7.2	7.3	7.3	7.4
	Org. Carbon %	0.24				
Sandy Plain	Colour	10 YR 6/4	10 YR 6/5	10 YR 5/6	10 YR 5/4	10 YR 6/6
	pH	7.0	7.1	7.2	7.2	7.5
	Org. Carbon %	0 28				

*10 YR 6/4 ... Light Yellowish brown.

10 YR 6/5 ... Light Yellowish Brown.

10 YR 5/6 ... Yellowish Brown.

10 YR 5/4 ... Yellowish brown.

10 YR 6/6 ... Brownish Yellow.

Table 2

Concentration of various nutrient elements of different depths at various sites for Prosopis juliflora DC growing in the Thar Desert of India

Nutrient element	Depth concentration			Site concentration			L SD & = 0 05
Calcium**	Surface	2.07	c*	1	3.44	a	0.27
	15 cm	2.22	bc	2	2.02	c	
	30 cm	2.38	b	3	2.28	c	
	45 cm	2.80	a	4	2.69	b	
	60 cm	3.01	a	5	2.05	c	
Magnesium**	Surface	3.62	a	1	4.47	a	0.27
	15 cm	3.35	b	2	2.85	bc	
	30 cm	3.24	bc	3	3.05	b	
	45 cm	3.07	c	4	2.82	b	
	60 cm	2.62	d	5	2.71	c	
Potassium**	Surface	2.83	b	1	2.89	bc	0.23
	15 cm	2.98	ab	2	2.99	b	
	30 cm	3.17	a	3	2.74	c	
	45 cm	2.96	ab	4	3.42	a	
	60 cm	2.88	b	5	2.78	bc	
Sodium**	Surface	2.60	NS	1	2 04	c	0.30
	15 cm	2.59	NS	2	2.50	b	
	30 cm	2.38	NS	3	3.00	a	
	45 cm	2.23	NS	4	2.42	bc	
	60 cm	2.32	NS	5	2.15	dc	
Phosphorus*	Surface	0.0918	NS	1	0.0855	NS	0.012
	15 cm	0.0928	NS	2	0.0897	NS	
	30 cm	0 0999	NS	3	0.0943	NS	
	45 cm	0.0952	NS	4	0.1023	NS	
	60 cm	0.0876	NS	5	0.0956	NS	
Carbonates*	Surface	1.4	c	1	2.1	b	0.42
	15 cm	1.7	bc	2	1.4	c	
	30 cm	2.1	b	3	2.6	a	
	45 cm	2.6	a	4	2.8	a	
	60 cm	2.9	a	5	1.8	bc	
Nitrogen*	Surface	0.0302	b	1	0.0271	a	0.018
	15 cm	0.0548	a	2	0.0177	ab	
				3	0.0166	ab	
				4	0.0099	b	
				5	0.0138	ab	

NS = Not significant

Only means followed by different letters in the column for each element differ significantly at 5% level. 'a' indicates a higher value than 'b' and so on.

* Figures in %

** Figures in m. eq/100 g. soil

The amount of phosphorus and nitrogen in the soils supporting *Prosopis juliflora* is usually small and this is more likely due to a poverty of organic matter. The nitrogen content of the sub-soil was higher than that of the top soil. Wild (1958) has attributed the comparatively low content of phosphorus to losses by leaching. This study reveals that difference in phosphorus, depth-wise or site-wise, is not significant.

A comparison of the quantity of various elements in the soil, both site-wise and depth-wise indicates that magnesium is comparatively higher. Gordon and Lipman (1926) are of the opinion that soils that contain a large excess of magnesium over calcium have frequently been found infertile. Lutz and Chandler (1946) further point out that soils with excessive amounts of magnesium usually are poor in other nutrient elements and such soils commonly have a high pH value which may contribute to the nutritional difficulties. The same has been observed in the present investigation.

(b) *Foliar Studies.* Tree leaves are the largest single source of soil organic matter and a substantial part of the currently available nutrients in the soil come from the annual litter falling on the ground. Lundegardh (1943) was of the opinion that analysis of the leaves taken at a stage when the plant was fully grown, has advantages over soil analysis because it indicated precisely the availability of the nutrients in the soil. Wichstrem and Braun (1955) established through leaf analysis the primary deficiency of potassium in the soils of orchids in Medford area.

Table 3 gives foliar contents of *Prosopis juliflora* It is seen that magnesium and phosphorus contents are less than 1 per cent but calcium and potassium range from 2.14 to 2 64 per cent and 2.05 to 2.69 per cent respectively. The leaves are richer in sodium which varies from 3.94 to 4.51 per cent. This indicates the capacity of the plant to tolerate salinity. Since the leaves are fairly rich in nitrogen content, they are likely to be useful as green manure. It is further seen that there is not much difference in foliar composition site-wise.

(c) *Soil-Plant Relationship.* The nutritional status of a plant can better be understood by an understanding of the amount of mineral elements in the leaves and its corresponding quantity in the soil and sub-soil (Lundegardh, 1943). In this study the potassium and phosphorus contents of the soil were fairly related to their foliar concentration with revalues of 0.74 and 0.61 respectively (Table 3). The foliar and soil contents for the other elements were not significantly related.

Table 3

Relationship between the plant and soil contents of various nutrient elements for Prosopis juliflora DC in the Thar Desert of India.

Site	Nutrient elements											
	Calcium		Magnesium		Potassium		Sodium		Phosphorus		Nitrogen	
	Plant	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant	Soil
	2.25	3.44	0.38	4.47	2.11	2.89	4.08	2.04	0.30	0.0855	3.311	0.0271
	2.36	2.02	0.48	2.85	2.43	2.99	4.26	2.50	0.45	0.0897	3.325	0.0177
	2.14	2.28	0.32	3.05	2.05	2.74	3.94	3.00	0.28	0.0943	3.300	0.0166
	2.64	2.69	0.54	2.82	2.69	3.42	4.51	2.42	0.51	0.1023	3.620	0.0099
	2.41	2.05	0.51	2.71	2.49	2.78	4.32	2.15	0.48	0.0956	0.345	0.0138
Correlation Coefficient (r)	0.55		0.53		0.74		0.40		0.61		0.44	

SUMMARY

A correlation of the nutrient content of the leaves with exchangeable cations in the soil for *Prosopis juliflora* DC. in the scrub forest of the Thar Desert of India has been presented. The soils supporting the tree are mostly yellowish brown, coarse, sandy, alkaline and having little organic carbon, nitrogen and phosphorus. Calcium and carbonates tended to increase with depth while magnesium showed a decrease. The amount of exchangeable calcium in the soil decreased mostly as the exchangeable sodium increased. In general, magnesium is comparatively higher in the habitat. Foliar analysis reveals that magnesium and phosphorus contents are less than 1 per cent but sodium is the highest indicating the capacity of the plant to tolerate the salinity. The correlation of the soil and foliar contents shows that potassium and phosphorus are fairly related (r=0.74 and 0.61 respectively).

क्षुद्ररोह का अध्ययन, प्रोसोपिस जुलीफ्लोरा डीकै० की पर्ण और मृदा पोष्याहार स्थिति

लेखक बी०एम० शर्मा

सारांश

भारत के थार मरु प्रदेश में होने वाले क्षुद्ररोह वनों में होने वाले प्रोसोपिस जुलीफ्लोरा डीकै० की पत्तियों में पाये जाने वाले पोष्याहार तत्वों का उसकी मृदा में मिलने वाले विनिमेय धनायनों से सह-सम्बन्ध इस अभिपत्र में प्रस्तुत किया गया है। इन वृक्षों की मृदाएं बहुधा पीलापन लिए भूरे रंग की स्थूल, रेतीली, क्षारीय हैं तथा उनमें बहुत कम जैव कार्बन, नाइट्रोजन और फास्फोरस (भास्वर) पाया जाता है। गहराई के साथ कैलशियम और इसके कार्बोनेट बढ़ते जाते हैं पर मैगनीशियम में कमी आती है। मृदा के विनिमेय कैलशियम में बहुधा कमी आती गई जैसे-जैसे विनिमेय सोडियम में वृद्धि होती गई। सामान्यत: इस प्राकृतावास में मैगनीशियम अपेक्षतया अधिक मात्रा में है। पर्ण विश्लेपण से पता चलता है कि मैगनीशियम और भास्वर (फास्फोरस) तत्व 1% से भी कम मात्रा में हैं परन्तु सोडियम की मात्रा अधिकतम है जिससे पादप की लवणता सहने की क्षमता का संकेत मिलता है। मृदा और पत्तियों के तत्वों का सह-सम्बन्ध दिखाता है कि पोटाशियम और फास्फोरस तत्व पर्याप्त सम्बन्धित (सं० 0·74 और 0.61) हैं।

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CUTTINGS TAKEN FROM BOTTOM ONE-THIRD PART OF *POPULUS CILIATA* PLANTS PERFORM BETTER

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Introduction

Populus ciliata by virtue of its fast rate of growth (Sharma and Kashyap, 1981), suitability of its wood for a number of end uses (Khan, 1981; Kumar *et al.*, 1981; Misra, 1981; Shukla, 1981) and its adaptability to temperate Himalayan region (Singh, 1981) is now considered to be a suitable species for temperate Himalayan areas. Nursery technology of this species has, however, not been standardised. Research work was accordingly initiated at Conifers Research Centre, Simla to standardise its nursery technology. As a part of this programme, investigations were carried out to study the performance of cuttings taken from different parts of nursery-grown plants of *Populus ciliata.*

Meterials and Methods

Two experiments, one each at Shilly and Shillaru nurseries, were carried out during 1981-82. Cuttings taken from bottom one-third, middle one-third and top one-third parts of one year old nursery-grown *Populus ciliata* plants were compared for their rootability and the growth of the resultant plants. These three treatments were replicated twenty times. While making the cuttings, each plant was measured for its length and was equally divided into three parts. Cuttings of 22.5 cm length were made from each one-third part of the plant and normally two cuttings were obtained from each section. The cuttings were inserted in the nursery beds at a spacing of 50 × 30 cm. The planting of cuttings at both Shilly and Shillaru research nurseries was done in the last week of February, 1981.

Progress of sprouting of the cuttings was recorded weekly. The survival percentage of the plants and the height and basal diameter of all the plants in a bed were recorded every month.

Results and Discussion

Table 1 summarizes the sprouting percentage under different treatments at the end of May i.e. about three months after the planting of cuttings.

Table 1

Sprouting percentage under different treatments

Treatments	Sprouting percentage	
	Shilly nursery	Shillaru nursery
Bottom one-third	97.50	90.75
Middle one-third	90.00	61.25
Top one-third	87.50	51.25

In Shilly nursery, the sprouting percentage of cuttings taken from bottom one-third parts of the plants was significantly (5% level) higher than that of the cuttings taken from either middle one-third or top one-third parts of the plants which did not differ significantly from each other. In Shillaru nursery also, the trend was similar, but the differences between the sprouting percentage of cuttings taken from bottom one-third parts of the plants and that of the cuttings taken from either middle one-third or top one-third parts of the plants were significant at 1% level.

Table 2 summarizes the survival of the plants expressed as a percentage of the sprouted cuttings.

Table 2

Survival percentage of plants as affected by different treatments

Treatments	Survival percentage	
	Shilly nursery	Shillaru nursery
Bottom one-third	80.33	85.07
Middle one-third	80.11	75.00
Top one-third	60.13	82.50

In Shilly nursery, the survival percentage of the plants arising from the cuttings taken from top one-third of the plants was lower (5% level) than that of those from cuttings taken either from middle one-third or bottom one-third of the plants which did not differ significantly from each other. In Shillaru nursery, however, the survival percentage of the plants was not significantly affected by the position of the cuttings.

The height and basal diameter of the plants under different treatments at successive intervals are shown in Figure 1. In terms of both height and basal diameter, the cuttings taken from bottom one-third of the plants produced better plants than those obtained from the cuttings taken from the middle one-third of the plants which in turn were better than those produced from the cuttings taken from the top one-third of the plants. The differences between different treatments in respect of these characters became evident from the very beginning and continued throughout the growing season.

The height and basal diameter of the plants at the end of the experiment (January, 1982) as affected by different treatments are presented in Tables 3 and 4 respectively.

Table 3

Height of plants as affected by different treatments

Treatments	Height of Plants (cm)	
	Shilly nursery	Shillaru nursery
Bottom one-third	200.56	110.36
Middle one-third	185.14	95.85
Top one-third	162.173	84.20

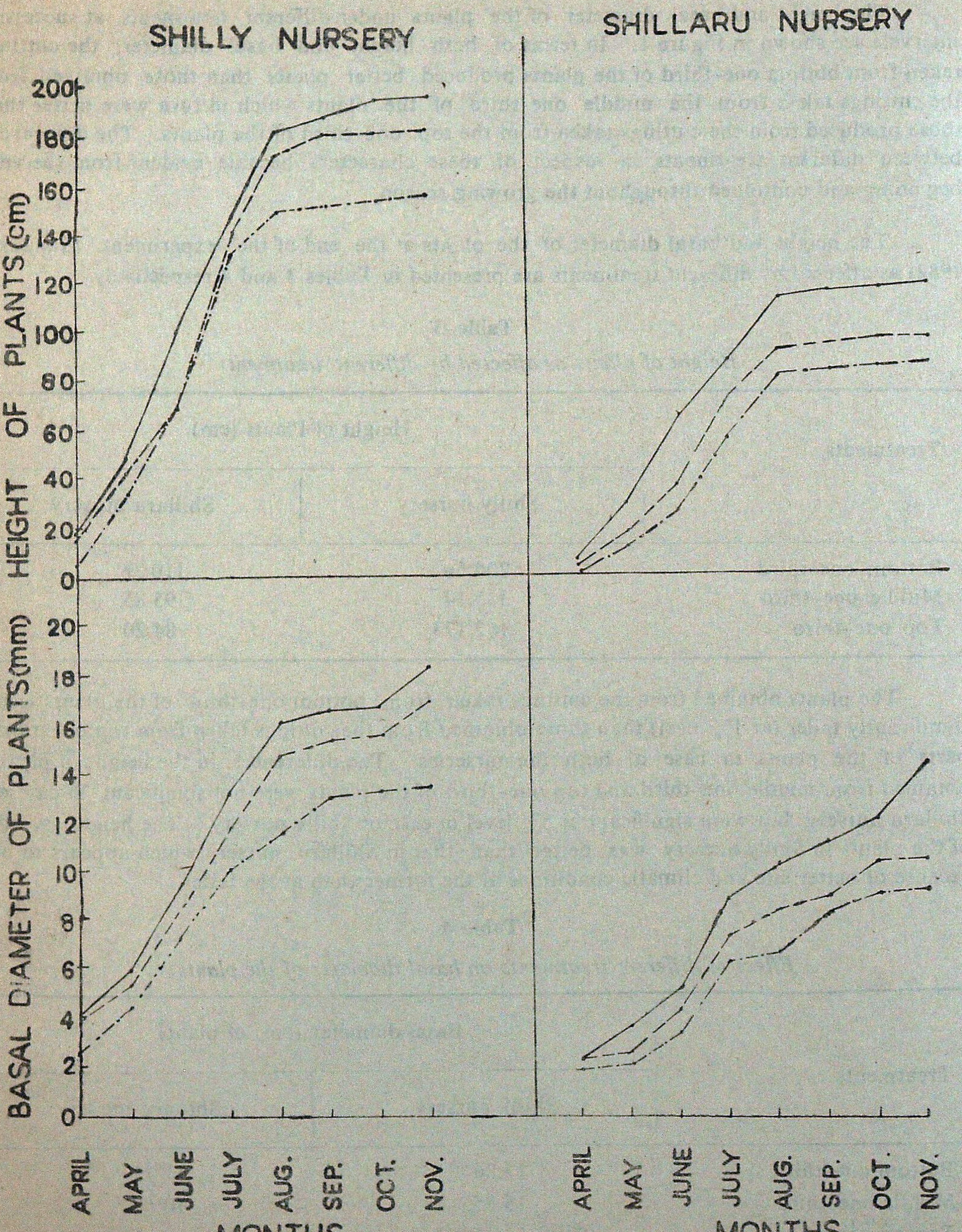
The plants obtained from the cuttings taken from bottom one-third of the plants were significantly taller (at 1% level) than those obtained from the cuttings taken from top one-third parts of the plants in case of both the nurseries. The differences in the height of plants obtained from middle one-third and top one-third of the plants were not significant in case of Shillaru nursery, but were significant at 5% level in case of Shilly nursery. The height growth of the plants in Shilly nursery was better than that in Shillaru nursery which appears to be because of better site and climatic conditions at the former than at the latter.

Table 4

Effect of different treatments on basal diameter of the plants

Treatments	Basal diameter (cm) of plants	
	Shilly nursery	Shillaru nursery
Bottom one-third	17.86	11.75
Middle one-third	16.85	10.68
Top one-third	14.31	9.03

Fig. 1



Height and Basal Diameter of Plants under different treatments.

Bottom one-third ——— Middle one-third ------ Top one-third –.–.–.–.

In case of both the nurseries, the plants obtained from the cuttings from bottom one third and middle one-third of the plants did not differ significantly in basal diameter, but had significantly more basal diameter than those produced from the cuttings taken from top one-third of the plants at 1% and 5% level respectively.

Better performance of the cuttings taken from bottom one-third of the plants as compared to those taken from either middle one-third or top one-third of the plants can be partly due to an uneven distribution of inhibiting substances in different parts of the shoot (F.A.O., 1979) and partly because of better nutritional status of these cuttings. Chmelar (1974) reported that thicker cuttings of willows rooted better then thinner cuttings because of higher nutrient reserves. The importance of nutrient balance in the cuttings of poplar for rooting has been imphasized by several workers (Nanda *et al,* 1971; Nanda *et al,* 1973; F.A.O , 1979). Proper nutritional balance is more important than the total nutrient content; poplar cuttings with higher C/N ratio root better than those with lower C/N ratio and the value of C/N is generally lower at the top than at the base of a single stem from which the cuttings are made (F.A.O., 1979). Accordingly, the poplar cuttings taken from the lower two-thirds of the plants have been found to perform better than those taken from the upper one-third portion (F.A.O., 1979). These results broadly support the findings of the experiments reported in this paper.

SUMMARY

Investigations carried out to determine the performance of cuttings taken from bottom one-third, middle one-third and top one-third portions of *Populus ciliata* plants showed that the cuttings taken from the bottom one-third parts of the plants performed better than those taken from the middle one-third which did better than those taken from the top one-third parts of the plants.

पापुलस सिलियाटा पादपों के निचले तिहाई भाग से काटी गई कलमें लगाने पर श्रेष्ठतर रहती हैं

लेखक आर०वी० सिंह, के०सी० शर्मा व पी०एस० कौशल

सारांश

पापुलस सिलियाटा पादपों के निचले तिहाई, मध्यम तिहाई और ऊपरले तिहाई भाग से ली गई कलमों को लगाने पर उनकी सक्रियता का विनिश्चय करने के लिये अन्वेषणों ने दिखाया है कि पौधे के निचले तिहाई भाग से ली गई कलमें उन पादपों के मध्यम तिहाई भाग से ली गई कलमों की तुलना में श्रेष्ठतर रही तथा मध्यम तिहाई भाग वाली कलमें उसी पादप के ऊपरले तिहाई भाग से ली गई कलमों के मुकावले में अधिक अच्छी चली।

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METALLIC PROPERTIES OF A NATURAL FIBRES REINFORCED COMPOSITE–BAMBOO

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Introduction

From the beginning of civilization, bamboo is being used as a basic structural material in poormen's huts, as beams and columns and for reinforcement in walls made of dried leaves. Though the civilization has advanced, yet the millions of people in villages live in dwellings made of bamboo and other materials available in nearby jungles and fields. All this has been possible due to the excellent properties of strength, toughness, lightness and straightness of bamboos.

Iyer (1933) has stated that Japanese used bamboos in aeroplane propellers. Ramchandani and Singh (1943) have stated that during the Second World War bamboos were used for military purposes such as air raid covers for buildings. These applications show that bamboo has served the role of important structural members. If the bamboo would not have served from the drawback of decay due to environmental attack, it would have continued as a basic structural material.

Now-a-days dams, bridges and buildings are enormously consuming the circular or rectangular, solid or hollow steel sections for reinforcement, which are not only heavy but also costly to manufacture. The present work suggests the possible replacement of steel sections by circular or rectangular, solid or hollow bamboo sections after providing a protective coating on them for the prevention of environmental attack. Austin and Ueda (1973) have stated that bamboos are artificially grown in rectangular sections with the help of rectangular frames.

Gupta and Jain (1980) have studied the change of veneer strength in laminated boards at different stages of resin treatment. In the present work, bamboo specimens (of *Dendrocalamus strictus*) were soaked in Araldite mixtures of various percentages of hardener (CIBA-CY 230 resin with 8, 10 and 12 per cent by weight of CIBA-HY 951 hardener). These bamboo specimens with Araldite covering of 1 mm thickness were kept in water for several weeks but no effect of water on them was observed and the Araldite - coating remained intact over these bamboo specimens. The Araldite soaking provided coating on bamboo specimens as in glass/epoxy composites with excellent properties of thermal and electrical insulation, lightness, strength and immunity to environmental attack.

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Many research workers in the past have analysed the mechanical and physical properties of timbers. For example, Sanyal and Gaherwar have studied the mechanics of Assam timbers. Mittal and Sanyal (1980) have studied the stress-strain hysterisis in timber at room temperature and different relative humidities. Still the literature on the mechanical properties of bamboo is not much. Shekhar and Bhartari (1960) have studied the mechanical behaviour of bamboos. Limaye (1952) has studied the strength of *Dendrocalamus strictus*, while Shekhar, Rawat and Bhartari (1962) have studied the strength of *Bambusa nutans*. All these research workers have determined the important mechanical properties as stress at elastic limit and Young's modulus of elasticity indirectly with the help of static bending test on centre-node and centre-internode specimens taking from a long bamboo. An Indian Standard (1973) 6874-1973 on bamboo strength also defines the machanical properties of a bamboo through indirect static bending test. In the present study, mechanical properties of commonly available and highly strong species of bamboo i.e. *Dendrocalamus strictus* with solid and hollow sections have been determined. Bamboo specimens with and without soaking in Araldite mixture were tested under tension and impact These bamboo specimens were not kiln-dried but these were obtained from fully seasoned and dried bamboos. The tubular specimens were tested in torsion and flat specimens with preferred fibre orientation were tested for Young's modulus of elasticity along the direction of loading.

It was observed that ultimate tensile strength of bamboo specimens is nearly equal to the yield strength of mild steel and their specific ultimate tensile strength is about six times the specific ultimate tensile strength of mild steel. Though the notch impact strength of bamboo specimens is only 15-20 per cent the impact strength of mild steel but the specific impact strength of unsoaked and soaked (in Araldite) samples of bamboo is one and half times and two times respectively the specific impact strength of mild steel. The torsional shear strength of tubular bamboo specimens is poor due to weak cellulose material in between the strong fibres.

It was further observed that bamboo has maximum stiffness along the fibres and minimum transverse to the fibres. The graph of modular ratio Ey/E_2 (ratio of Young's modulus of specimen with preferred fibre orientation along the axis of loading to the Young's modulus of specimen when the fibres are transverse to loading axis) is similar to the graphs of modular ratio for various fibre orientation for glass/epoxy and boron/epoxy composites as shown in the book by Jones (1975).

Preparation of Specimens

Specimens for tension, impact and torsion tests were made from the commonly available quality of bamboo i.e. *Dendrocalamus strictus* with a local name of 'Lathi'. Fig. 1 shows the dimensions of these specimens.

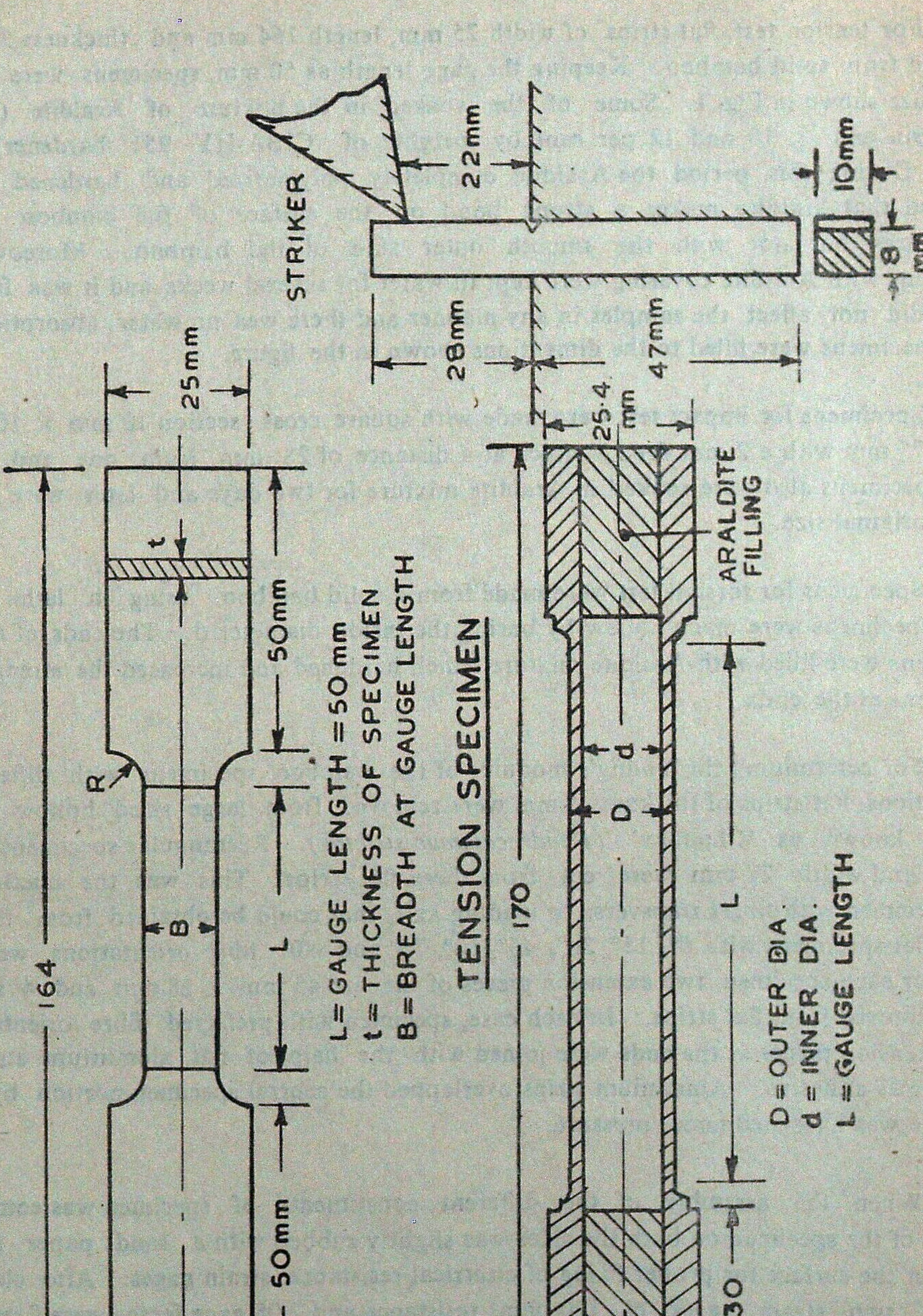

STRIKER
22mm
10mm
8 mm
28mm
47mm
25mm
164
t
50mm
R
B
L
50mm
L= GAUGE LENGTH = 50 mm
t = THICKNESS OF SPECIMEN
B = BREADTH AT GAUGE LENGTH
TENSION SPECIMEN
25.4 mm
ARALDITE FILLING
170
d
D
L
30
D = OUTER DIA.
d = INNER DIA.
L = GAUGE LENGTH

Fig. 1

Impact Specimen

Torsion Specimen

For tension test, flat strips of width 25 mm, length 164 mm and thickness 3 mm were removed from solid bamboo. Keeping the gage length as 50 mm, specimens were machined to the size shown in Fig. 1. Some of the soaked in the mixture of Araldite (CIBA-CY 230 resin and 8, 10 and 12 per cent by weight of CIBA-HY 951 hardener) for two days. During this period the Araldite completely polymerized and hardened It was observed that Araldite makes a strong bond on the surface of the bamboo specimens with fibres but not with the smooth outer skin of the bamboo Moreover, some specimens with Araldite covering were kept in water for several weeks and it was found that water did not affect the samples in any manner and there was no water absorption. Then these specimens were filled to the dimentions shown in the figure.

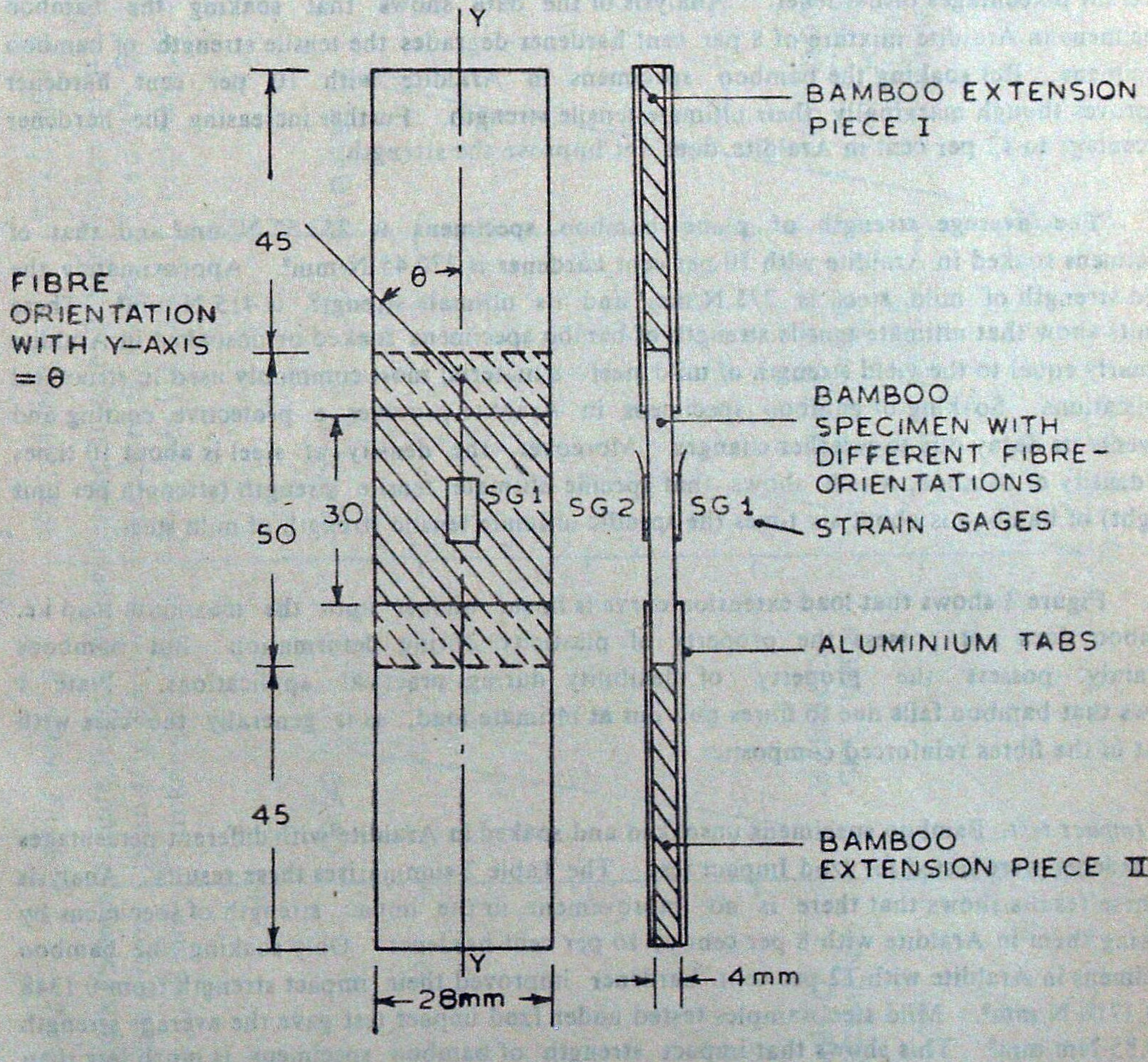
Specimens for impact test were made with square cross section 10 mm × 10 mm and length 75 mm with a 2 mm deep V-notch at a distance of 28 mm from one end. Some of these specimens also were soaked in Araldite mixture for two days and later were machined to the original size.

Specimens for torsion test were made from a solid bamboo, using a lathe machine. These specimens were made hollow by boring the inside diameter d. The ends of the torsion specimens were filled with Araldite mixture which hardened and increased the strength of the specimens at the ends.

For determining the Young's modulus of the bamboo specimens with different fibre orientations, flat strips of thickness 4 mm were removed from large sized hollow bamboos, locally known as 'Chadhav' *(Dendrocalamus strictus)*. Rectangular specimens of length 50 mm and width 28 mm were cut from these flat strips. This was the maximum size of a specimen with fibres transverse to loading axis, that could be obtained from flat strips. Seven flat specimens with 0°, 15°, 30°, 45°, 60°, 75° and 90° fibre orientations were made. Then for each specimen, two extension pieces of the size 45 mm × 28 mm and 4 mm thick were removed from flat strips. In each case, specimen with preferred fibre orientation and two extension pieces at the ends were joined with the help of flat aluminium strips using Araldite as adhesive. Aluminium strips overlapped the central specimen portion by 10 mm. Araldite was hardened under pressure.

When the assembly of the different constituents of specimen was complete, the surface of the specimen on both the sides was slightly rubbed with a sand paper so as to even out the surface for proper fixing of electrical resistance strain gages. After cleaning the surface, two strain gages of 120 ohms resistance and 2.08 gage factor were fixed on both the sides as shown in Fig. 2. The axis of the strain gages coincided with the axis of loading. After complete curing of the adhesive used for fixing the strain gages, leads were soldered to the terminals of strain gages, so that these can be connected in the Wheat-stone bridge circuit for strain measurement. Then the strain gages were covered with very thin layer of wax for moisture proofing.

Fig. 2


Y
45
FIBRE ORIENTATION WITH Y-AXIS = θ
θ
30
50
SG1
SG2
SG 1
45
Y
28mm
4mm
BAMBOO EXTENSION PIECE I
BAMBOO SPECIMEN WITH DIFFERENT FIBRE-ORIENTATIONS
STRAIN GAGES
ALUMINIUM TABS
BAMBOO EXTENSION PIECE II

Bamboo specimen used for determination of Young's Modulus of Elasticity at different fibre—orientations

Results and Discussion

1. *Tension test.* Tensile test on specimens was performed using a Universal testing machine with automatic plotting of Load-extension curve. Fig. 3 shows these curves for unsoaked and soaked specimens in Araldite with 10 per cent hardener. Table 1 summarises the ultimate tensile strength of bamboo specimens, unsoaked and soaked in Araldite with different percentages of hardener. Analysis of the data shows that soaking the bamboo specimens in Araldite mixture of 8 per cent hardener degrades the tensile strength of bamboo specimens. But soaking the bamboo specimens in Araldite with 10 per cent hardener improves though marginally their ultimate tensile strength. Further increasing the hardener percentage to 12 per cent in Araldite does not improve the strength.

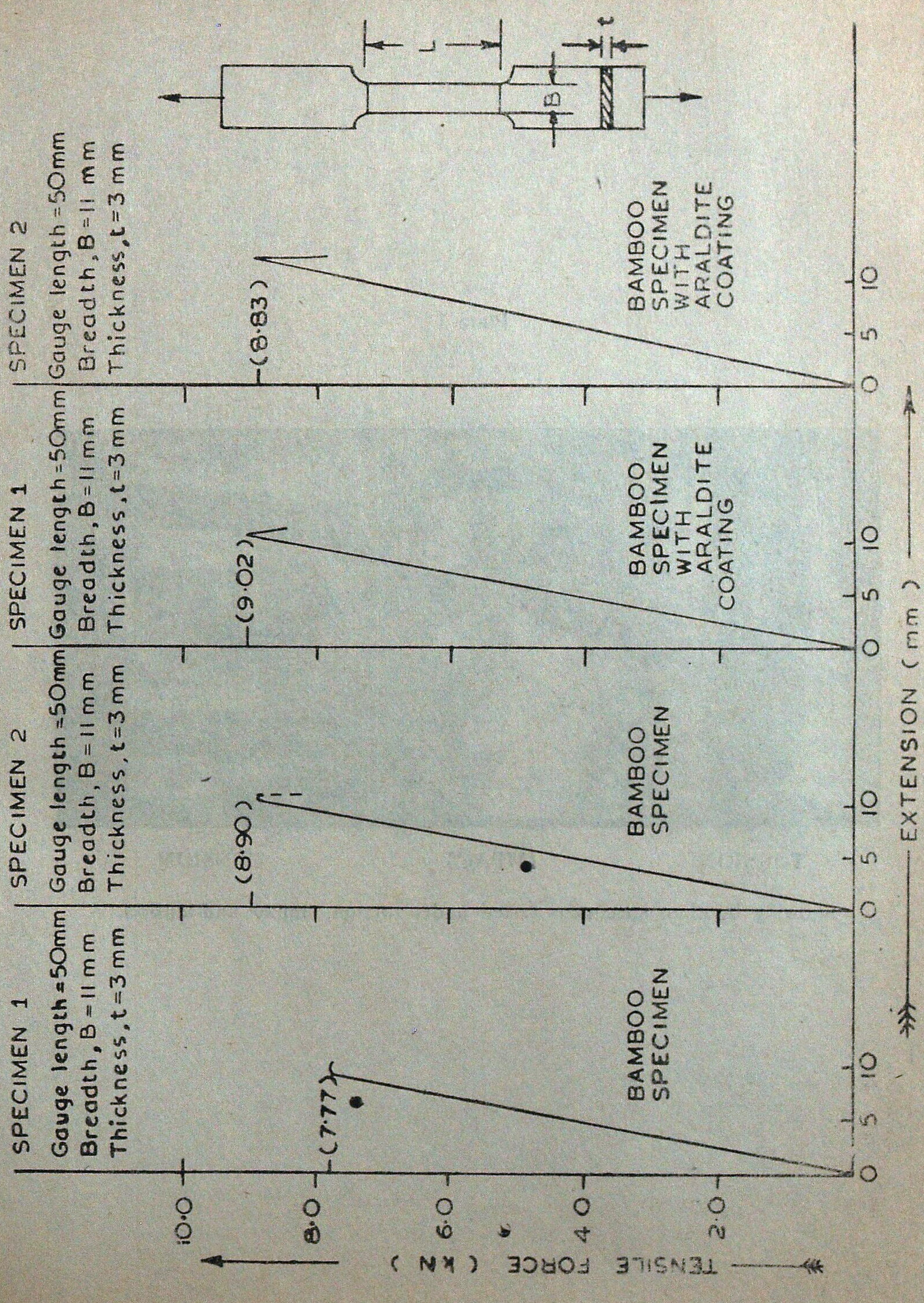
The average strength of plane bamboo specimens is 252.57 N/mm^2 and that of specimens soaked in Araldite with 10 per cent hardener is 270.45 N/mm^2. Approximately the yield strength of mild steel is 275 N/mm^2 and its ultimate strength is 415 N/mm^2. These results show that ultimate tensile strength of bambo specimens soaked or unsoaked in Araldite is nearly equal to the yield strength of mild steel—a material most commonly used in structural applications. Soaking of bamboo specimens in Araldite provides a protective coating and prevents its decay due to weather changes. Moreover, the density of steel is about 10 times the density of bamboo, which shows that specific ultimate tensile strength (strength per unit weight) of bamboo is about six times the specific ultimate tensile strength of mild steel.

Figure 3 shows that load extension curve is linear almost upto the maximum load i.e. bamboo does not possess the property of plasticity during deformation But bamboos certainly possess the property of flexibility during practical applications. Plate 1 shows that bamboo fails due to fibres pull out at ultimate load, as is generally the case with most of the fibres reinforced composites.

2. *Impact test.* Bamboo specimens unsoaked and soaked in Araldite with different percentages of hardener were tested for Izod Impact test. The Table 2 summarises these results. Analysis of these results shows that there is no improvement in the impact strength of specimens by soaking them in Araldite with 8 per cent or 10 per cent hardener. Only soaking the bamboo specimens in Araldite with 12 per cent hardener improved their impact strength from 0.1348 to 0.1716 N/mm^2. Mild steel samples tested under Izod impact test gave the average strength as 0.85 Nm/mm^2. This shows that impact strength of bamboo specimens is much less than the impact strength of mild steel Again taking into account the densities of bamboo and mild steel, it is observed that specific impact strength of unsoaked and soaked bamboo specimens is respectively 50 per cent and 100 per cent more than the specific impact strength of mild steel.

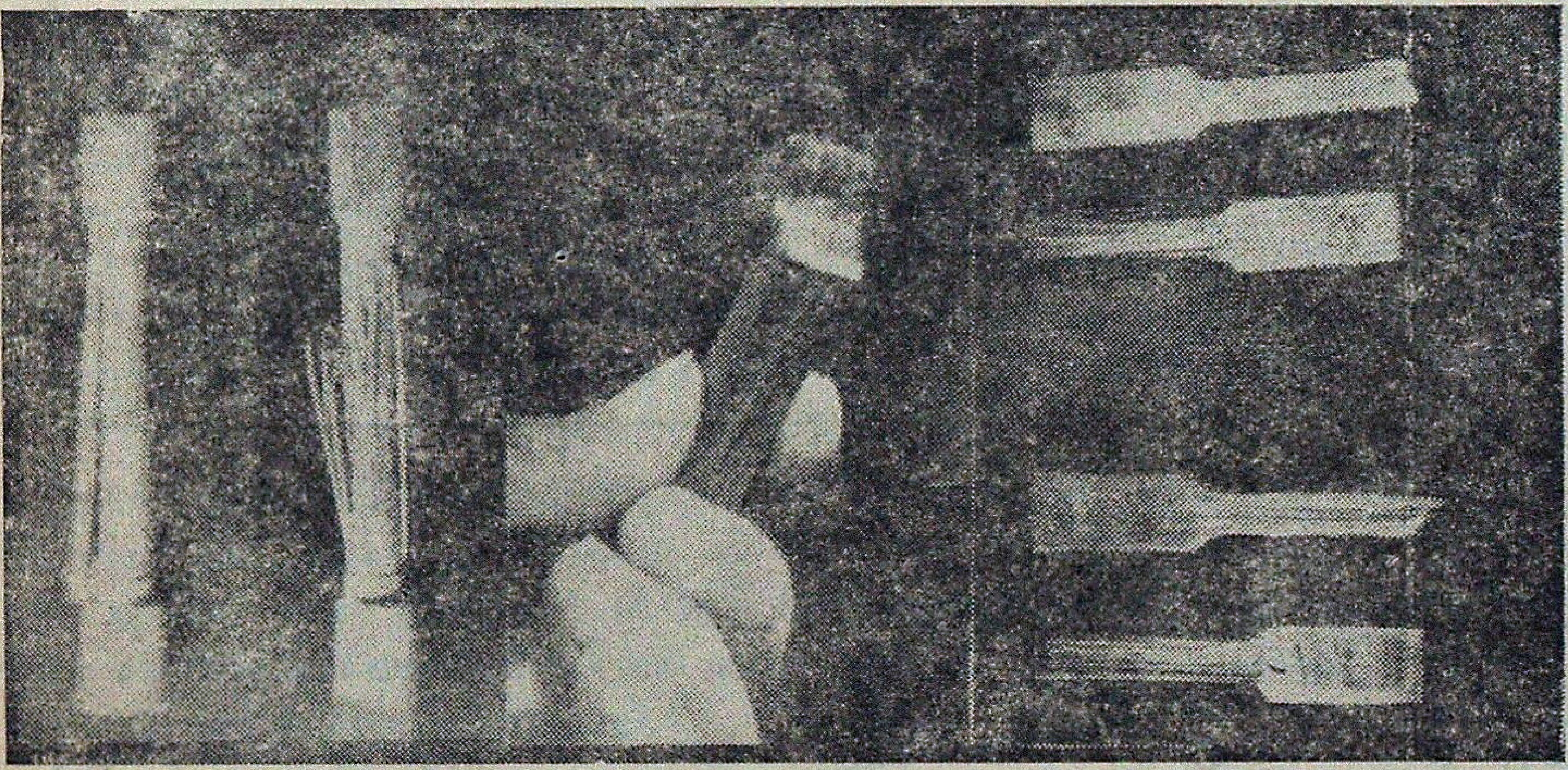
Plate 1 of a fractured sample of bamboo shows the fibres pull out near the region of notch and straight brittle type fracture near the other side of the specimen.

Fig. 3



Load-extension Curves of Bamboo Specimens

Plate 1



TORSION IMPACT TENSION

Showing bomboo specimens tested under torsion, impact and tension.

Table 1

Ultimate Tensile Strength of Bamboo Specimens

Specimen number	Remarks	Ultimate load kN	Section dimensions mm × mm	Ultimate tensile strength N/mm²
1.	—	7.77	11 × 3	235.45
2.	—	8.90	11 × 3	269.69
3.	Soaked in Araldite with 8% hardener	7.35	11 × 3	222.72
4.	Soaked in Araldite with 8% hardener	5.88	11 × 2.8	190.90
5.	Soaked in Araldite with 10% hardener	9.02	11 × 3	273.33
6.	Soaked in Araldite with 10% hardener	8.83	11 × 3	267.57
7.	Soaked in Araldite with 12% hardener	8.04	11 × 3	243 63
8.	Soaked in Araldite with 12% hardener	7.65	11 × 33	231.81

Table 2

Impact Strength of Bamboo Specimens

Specimen Number	Remarks	Impact energy Nm	Impact strength Nm/mm²
1.	—	9.80	0.1225
2.	—	10.79	0.1348
3.	—	10.79	0.1348
4.	—	10.79	0.1348
5.	Soaked in Araldite with 8% hardener	10.79	0.1348
6.	Soaked in Araldite with 10% hardener	10.79	0.1348
7.	Soaked in Araldite with 10% hardener	10.79	0.1348
8.	Soaked in Araldite with 12% hardener	12.75	0.1593
9.	Soaked in Araldite with 12% hardener	13.73	0.1716

3. *Torsion test.* The tubular specimens of bamboo (Fig. 1) were tested upto fracture on a Torsion testing machine. Fig. 4 shows the torque versus angular twist curves for these specimens and Table 3 gives the torsional shear strength of bamboo specimens. These results show that the average torsional shear strength of bamboo is 5.99 N/mm². The round specimen of mild steel tested under torsion gave the maximum torsional yield strength as 147 N/mm². So, the ultimate torsional shear strength of bamboo specimens is very much less than the torsional shear strength of mild steel. The bamboo specimens failed at angular twist between 50° – 100°, while the mild steel specimen failed at 1430°. These observations show that hollow bamboos have very poor torsional strength.

Table 3

Torsional Shear Strength of Bamboo Specimens

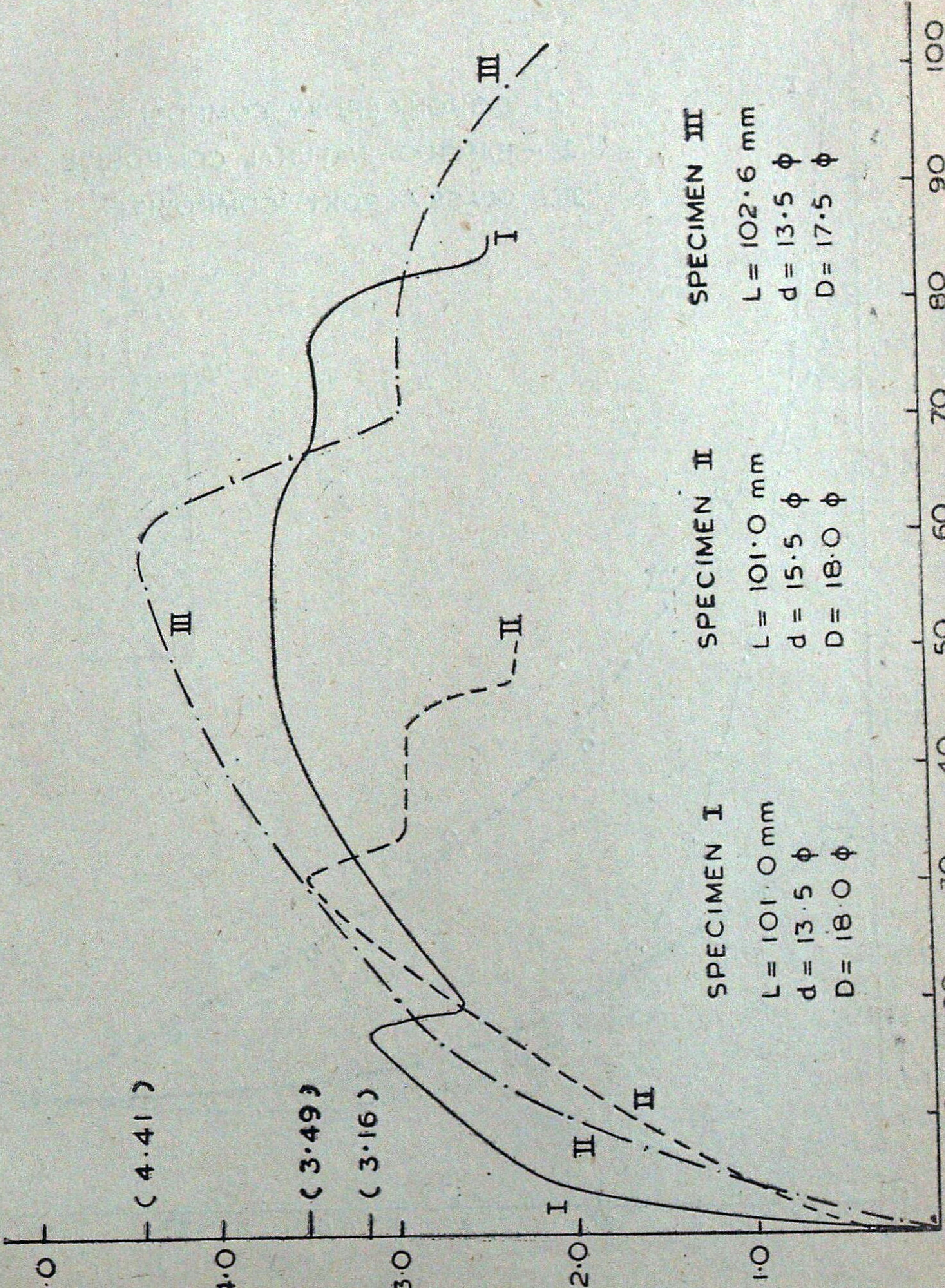
Specimen Number	Gauge length L (mm)	Outside diameter D (mm)	Inside diameter d (mm)	Maximum torque (Nm)	Torsional shear strength (N/mm²)
1.	101.0	18.0	13.5	3.69	4.71
2.	101.0	18.0	15.5	3.49	6.77
3.	102.6	17.5	13.5	4.41	6.49

Fig. 4 shows that once the maximum torque is reached the strength of specimens falls drastically. At this stage, the longitudinal cracks develop and fibres are separated in the specimen. Plate 1 shows the separated fibres of bamboo specimens —a typical fracture mode for fibre reinforced composites under torsional loads.

4. *Test for Young's modulus of elasticity.* Two electrical resistance strain gages of the specimen being tested alongwith two strain gages of another unloaded sample (for temperature compensation) were connected to the terminals of a junction box, making a Wheat-stone bridge circuit. The output of the junction box was fed to a strain gage amplifier which directly gave the readings of strain when the specimen was loaded. All the specimens with central portion with preferred fibre orientation (Fig. 2) were tested in the same manner. In each case a graph between tensile stress and strain was plotted. After getting the best fit straight line through the observations, the slope of graph was determined, which is the value of Young's modulus of elasticity Ey of the specimen along the direction of loading. The Table 4 summarises the values of Young's modulus Ey along the axis of loading.

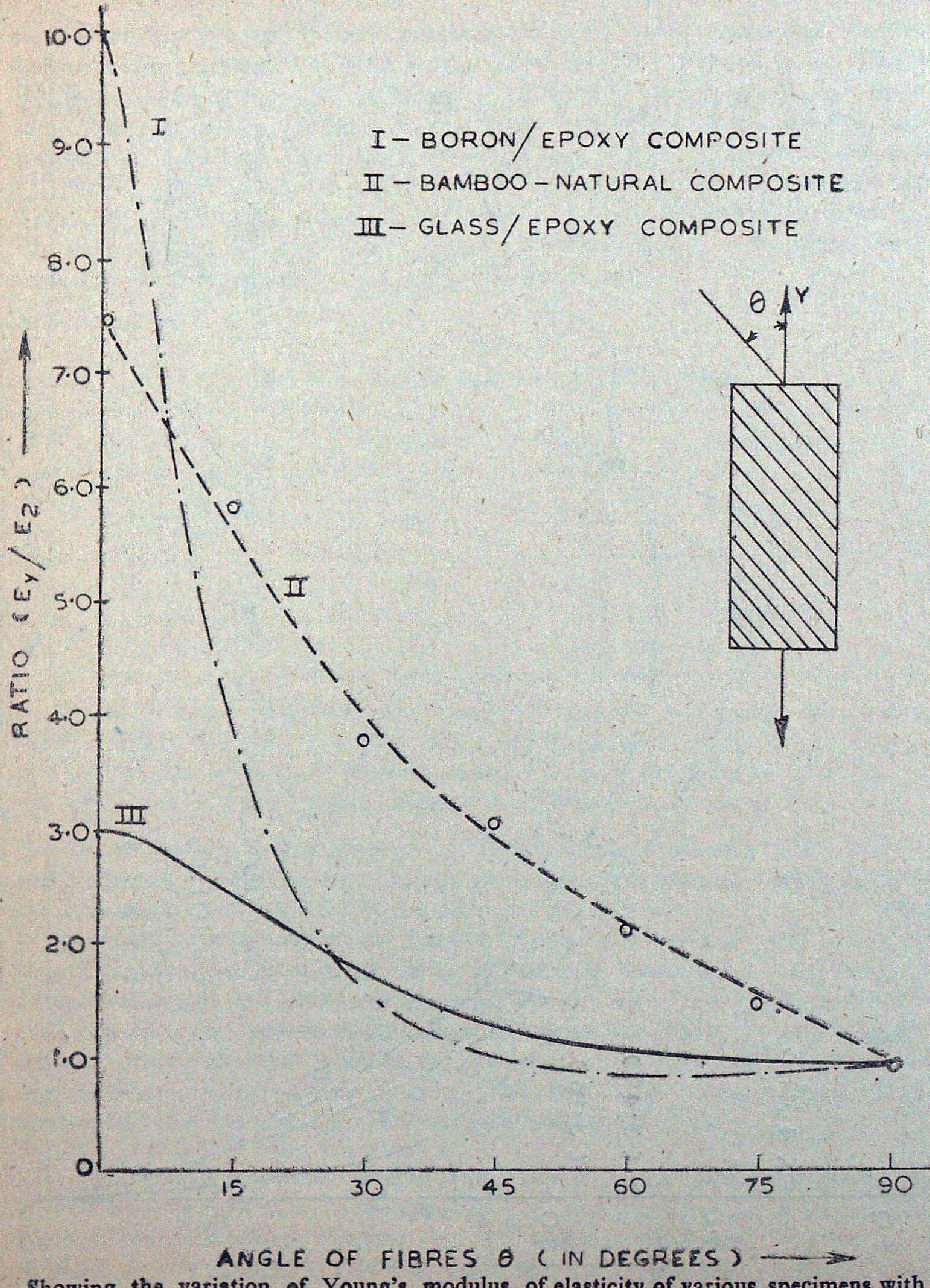
These results show that specimen with fibres along the axis of loading has maximum value of Young's modulus while the specimen with fibres transverse to the axis of loading has minimum values of Young's modulus, Ey. The specimen with fibres at 90° to the axis of loading gives the value of E^{2}' i.e. transverse Young's modulus. Fig. 5 shows the comparison of ratio Ey/E^{2} for different fibre orientation of bamboo specimens with those for

Fig. 4



Torque–Angular Twist Curves for Tubular specimens of Bamboo

Fig. 5



Showing the variation of Young's modulus of elasticity of various specimens with orientation of fibres

Glass/Epoxy and Boron/Epoxy composites, as given in the book by Jones (1975). It is observed that the behaviour of the bamboo specimens is similar to the artificially developed composites and their ratio $E_{max.} / E_{min.}$ or Ey/E_2 lies in between the ratios for Boron/Epoxy and Glass/Epoxy composites.

Table 4

Young's Modulus of Elasticity of Bamboo Specimens

Specimen	Orientation of fibres with respect to Y–Axis	Young's modulus of elasticity kN/mm²
1.	0°	8.473
2.	15°	6.276
3.	30°	3.923
4.	45°	3.236
5.	60°	2.466
6.	75°	1.667
7.	90°	1.128

Conclusions

On the basis of the results obtained from various tests, following conclusions can be drawn :

- The average ultimate tensile strength of specimens made of *Dendrocalamus strictus* bamboo is nearly equal to the yield strength of mild steel.
- If the bamboo specimens are soaked in Araldite so as to provide them a coating for the prevention of decay, the ultimate tensile strength of bamboo increases though marginally.
- The specific ultimate tensile strength of bamboo specimen is nearly six times the specific ultimate tensile strength of mild steel. But mild steel is ductile in mechanical behaviour and bamboo specimens are brittle—similar to the behaviour of fibre reinforced composites.
- The notch impact strength of bamboo specimens is only about 15-20 per cent the impact strength of mild steel. But by taking into account the densities of mild steel and bamboo, the specific impact strength of bamboo specimen is 50 per cent greater and specific impact strength of bamboo specimen soaked in Araldite is 100 per cent greater than the specific impact strength of mild steel.

— Bamboo specimens have poor torsional shear strength in comparison to the torsional shear strength of mild steel. This is due to the longitudinal cracks developed in bomboo specimens under torsional loading. Similarly in fibre-reinforced composites, the matrix material fails under torsion much before the fibres can fail.

— Bamboos have maximum stiffness along the fibres and minimum stiffness transverse to the fibres. The variation of modular ratio (Ey/E_2) for bamboo specimens is similar to the variation of modular ratio of fibres reinforced composites.

SUMMARY

From the very beginning, bamboo is being used for many industrial, commercial and structural applications, yet the literature on mechanical behaviour of bamboo is not much. In the present work, bamboo specimens have been tested under torsion, tension and impact. The effect of protective coating of Araldite on bamboo specimens for the prevention of environmental attack also has been investigated.

It was observed that the strength and stiffness of bamboo are maximum along the fibres and minimum transverse to the fibres. The tensile and impact strength of bamboo specimens increase if these are soaked in Araldite mixture for two days. The ultimate tensile strength of bamboo specimen is equal to the yield strength of mild steel. But the notch impact strength and torsional shear strength of bamboo are much less in comparison to those of mild steel.

The mechanical behaviour and mode of fracture of bamboo specimens under various types of loading are similar to those of artificially developed fibre-reinforced composites.

प्राकृतिक रेशों से संग्रथित बांस के धात्विक गुण

लेखक यु॰सी॰ जिंदल

सारांश

प्रारम्भिक काल से ही बांस बहुत सारे औद्योगिक, व्यावसायिक और संरचनात्मक उपयोगों में लगाया जाता आ रहा है तथापि बांस के संधारी व्यवहार विषयक वाङ्मय अधिक उपलब्ध नहीं है। प्रस्तुत कार्य में बांस के नमूनों का विमोटन (टार्शन), आतनन और संघट्टन के अधीन परीक्षण किया गया। बांस के नमूनों पर वातावरण के दुष्प्रभावों की रोकथाम के लिए एरल्डाइट का सुरक्षा लेप करने का प्रभाव भी अन्वेशित किया गया।

देखने में यह आया कि बांस की मजबूती और दृढ़ता रेशों के समानान्तर अधिकतम और उसके तिर्यक न्यूनतम है। बांस के नमूनों की आतनन और संघट्टन के अधीन परीक्षण किया गया। शक्तियां नमूनों को दो दिन तक एरल्डाइट विलयन में डूबो कर रखने पर बढ़ती हैं। बांस नमूनों की अन्तिम (अधिकतम) क्षेत्र आतनन शक्ति मृदु फौलाद के बराबर है। परन्तु बांस की खांचा संघट्टन और विमोटन कार्तरण शक्तियां मृदु फौलाद की तुलना में उससे कहीं बहुत कम है।

विभिन्न प्रकार के लदान कार्य में बांस नमूनों का संधारी व्यवहार और उसके भंजन की प्रक्रिया कृत्रिम रूप से बनाये हुये रेशा संबलित संग्रथित पदार्थों जैसे ही हैं।

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PROVISIONAL GROWTH ESTIMATE OF *PTEROCARPUS DALBERGIOIDES* (ANDAMAN PADAUK)

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Pterocarpus dalbergioides (Andaman padauk) is large semi-deciduous or practically deciduous to evergreen tree with stout ascending and spreading branches often with very large buttresses. The species is indigenous to Andamans and Nicobar Islands only and occurs from near sea level to about 90 m elevation. The best growth is attained in well drained lower slopes of hills and in broader valleys This species has been tried with success in Kannoth and Wynaad Forest Divisions. In Kannoth it attained a height of 25 m in 12 years.

Andaman Padauk is a reputed timber well suited for heavy carpentry works, high class furniture and decorative works like panelling, parquet floors, balustrades etc. It also makes attractive plywood.

Mixed with *Canarium euphyllum*, *Sterculis campanulata* and some other miscellaneous species like *Terminalia bialata, Lagerstroemia hypoleuca Albizia lebbek*, *Bombax insigne* etc., in 4 years, it acquires mean top height of 8.2 m and crop diameter of 5.5 cm (top diameter 8.6 cm) as revealed in measurements of Sample Plot No. 31–36 of North Andamans In eigth year old Sample Plots (No. 28 and 29) recorded mean top height was 13.6 m with crop diameter of 11.3 cm (top diameter 16.8 cm).

On account of its fast rate of growth and economic value, attempt is made to study its rate of growth which is considerably faster in plantations as compared to natural forests.

Data to determine species dependent coefficients of growth model were derived from 9 Sample Plots mentioned hereunder :

	S. Plot No.
North Andamans Division	25, 28, 29 & 30
South Andamans Division	1, 2, 3, 4 & 8

In all there were 18 measurements, due to paucity of data, this study should be treated as *provisional*. Mean and standard deviation of basic parameters used are given as follows to indicate size and range of data.

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* Presently Project Director, Land Project Directorate, (Forest Department), Dehra Dun.

Parameter	Mean	Standard deviation	Denoted in text by	Units
Age	31.9	20.0	A	year
Top height	25.9	8.2	H	m
Standard timber volume/ha (before thinning)	128.87	97.14	V1 + V3	m^3
Total volume/ha (before thinning)	202.48	97.58	V2 + V4	m^3
Basal area/ha	19.05	6.06	BA	m^2
Basal area ratio	0.794	0.153	$BR = BA/BA_{Max}$	—
Number of trees/ha (before thinning)	499	351	S1 + S2	—
Height ratio	1.003	0.085	HR=(H/Mean height from curve)	—

A perusal of standard deviation of Height ratio indicates that there is not much variation in Top height for the same age. Hence no attempt will be made to distinguish site qualities.

Methodology

Following relationships were developed. These relationships are valid for the range covered in basic data.

1. *Site quality function*

$$\text{Log}_e H = 5.29963 - 3.94173\ A^{-.2}$$

$$r = .972$$

2. *Crop diameter function*

$$\text{Log}_e (D2) = (1.85809 - 0.65428\ BR^2) \log_e H + 3.05282\ BR - 8.40884$$

$$r = .985$$

Where D2 is mean crop diameter before thinnings.

Height ratio (H/Mean height from curve) and its various interactions with other variables were also used but none of them was found to have a significant effect.

3. *Volume functions*

(a) $$V1 + V3 = (0.46879/BR^{.6} + 0.47756\ BR^2 - 0.60663\ BR)\ BA.H. - 67.78491$$

$$r = .981$$

(b) $$V2 + V4 = (1.20670 + 1.47321\ BR^2 - 2.31663\ BR)\ BA.H. + 28.25635$$

$$r = .965$$

(c) $$\log_e [V1/(V1+V3)] = (6.16290\,BR^2 - 0.05173\,HR + 2.00557/BR - 7.90918\,BR) \times \log_e [S1/(S1+S2)] - 0.00308$$

where V1 is timber volume/ha after thinning.

$r = .934$

(d) $$V2/(V2+V4) = 0.45818\,S1/(S1+S2) + 0.54184$$

where V2 is total volume/ha after thinning.

$r = .873$

Equation (c) and (d) is aimed to reduce standing volume before thinning to standing volume after thinning. The correlation coefficient of these regressions is not high. These figures could not be improved significantly by adding more variables. Probably in thinnings, the removal of thinning has not followed any systematic pattern (i.e. low thinning, mechanical or crown thinning) and hence this situation. Therefore, crop volume values will be more reliable than volume after thinnings generated in growth tables.

4. *Maximum basal area curve*

Graph between Top height and basal area/ha was plotted. Freehand curve was drawn to cover the maximum observed values (BA_{Max}). Suitable function to fit points taken from hand drawn curve was found.

$$\log_e (BA_{Max}) = 3.43015 + 4.51314 \log_e (1 - e^{-.12844H})$$

Top height corresponds to the height of a tree of top diameter, where top diameter is mean diameter of 125 thickest trees/ha.

Maximum basal area curve helps to define capacity of soil and provides a check against simulating unrealistic values. The yield table is generated from these regressions for mean quality class (Table 1) for BR=1.

Conclusion

The maximum mean annual increment of Andaman padauk is about 14 m^3 for medium site and the rotation of harvest is indicated between 10 to 15 years. For maximum timber production, the rotation lies between 25 to 30 years when it produces 6.5 m^3 per hectare per annum of timber volume.

In this species, for high class furnishings, it is the heartwood which is in great demand in trade. The percentage of heartwood is very less in small sized trees and it increases with tree size. The following regression gives sapwood % in timber volume.

Sapwood % = 89.06004 − 16.07897 × standard timber volume of a tree
(correlation coefficient $r = .524$)

In small trees heartwood is hardly 10% while it becomes 30 to 40% in trees of 40 cm diameter. Further the value of correlation coefficient is very low which points out that probably locality has a marked influence on quantum of heartwood production. However, in order to get high heartwood yield, the rotation for felling will have to be very much higher.

Table 1

Age (yrs)	Top height (m)	Crop diameter (m)	No. of trees/ha	Basal area per ha (m²)	Volume/ha (m³)		Thinning volume (m³)		M.A.I. (m³)	
					Standard timber	Total wood	Standard timber	Total wood	Standard timber	Total wood
1	2	3	4	5	6	7	8	9	10	11
5	11.5	0.089	1541	9.588	0	68.312	0	8.082	0	13.662
10	16.7	0.140	1143	17.605	32.094	135.062	1.690	13.478	3.209	14.314
15	20.2	0.176	894	21.755	81.505	187.900	3.664	16.078	5.546	13.964
20	23.0	0.206	727	24.253	121.717	230.901	4.476	16.148	6.354	13.427
25	25.3	0.231	616	25.831	154.230	265.669	4.735	15.408	6.562	12.778
30	27.2	0.252	538	26.866	180.467	293.725	4.841	14.753	6.501	12.097
35	28.9	0.271	479	27.620	203.386	318.233	4.926	14.300	6.365	11.491
40	30.4	0.288	432	28.171	223.151	339.369	4.897	13.671	6.187	10.940
45	31.8	0.304	394	28.604	241.227	858.698	4.663	12.507	6.010	10.458
50	33.0	0.318	364	28.921	256.441	374.968	—	—	5.807	9.988

Note : Value in Col. 2 to 7 pertain prior to thinnings.

Andaman padauk is a tree with pronounced buttresses. It is often not possible to measure diameter at breast height which often is measured at 3.0479 m (10′). The relationship between these two diameters is given by the following regression—

$$\text{Diameter at breast height} = -0.19370 + 1.12074 \times \text{diameter at } 3.0479 \text{ m height (based on 157 observations)}$$

$$r = .991$$

SUMMARY

Information on growth of *Pterocarpus dalbergioides* (Andaman padauk) is scanty and no attempt was to estimate period of harvest for this species. Though the growth data is limited, yet attempt is made to study its growth pattern and project the same in the form of yield table.

प्टेरोकार्पस डलबर्गिआयडिस (अडमान पडौक) का अन्तरिम वृद्धि आकलन

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सारांश

प्टेरोकार्पस डलबर्गिआयडिस (अंडमान पडौक) की वृद्धि के सम्बन्ध में बहुत कम जानकारी उपलब्ध है और इस वृक्ष जाति की फसल लेने की अवधि का अनुमान लगाने का भी कोई प्रयास नहीं किया गया है। इसकी वृद्धि का क्षेत्र बहुत सीमित है, तथापि इसकी वृद्धि के प्रारूप के अध्ययन और उसके परिणामों को प्राप्ति सारणी के रूप में प्रस्तत करने का यह प्रयास किया गया हैं।

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HIGH YIELD PULPS FROM KENAF

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Introduction

Kenaf commonly known as Mesta is a fast growing annual plant having fairly high amount of strong fibres. In recent years, kenaf has gained more importance in several countries as a potential source for papermaking and extensive studies (White, 1969; Miller, 1965) have been carried out in U.S A. on the agronomical and papermaking aspects of this raw material. Kenaf can be a good alternative raw material for papermaking in India. where shortage of conventional raw materials is posing a problem to the growth of the industry.

In India it is mainly grown in Bihar, Assam, Orissa, Andhra Pradesh, Madhya Pradesh and Tamil Nadu. The climate of South India being most suited for its growth, a part of Andhra Pradesh depends upon this crop only.

Studies carried out on Kenaf have indicated that it can be processed to produce pulps with properties and performance equal to most softwoods and superior to most hardwoods. Kenaf papers have many characteristics difficult to obtain from wood. It may also be used as a blend to improve lower quality pulp.

In U.S.A , newsprint has been produced from 100% Kenaf TMP pulp and 40% Kenaf/60% hard and softwood fibres respectively (Anon. 1977). Papers with strength generally comparable to commercial newsprint have been produced from furnishes containing bleached kenaf TMP and at least 12% long fibre chemical pulp (Anon. 1980).

Investigations carried out on kenaf (Guha *et al.*, 1978; Sharma *et al*, 1983) at Forest Research Institute, Dehra Dun have shown its suitability for various grades of papers.

In the present investigation, high-yield pulps suitable for newsprint have been produced from kenaf by chemi-mechanical pulping processes. The results are recorded in this article.

Experimental

Raw Material. For this investigation, kenaf was obtained form Vamsadara Paper Mills Ltd , Srikakulam (A.P.). Whole sticks with bark were used for pulping studies after cutting them with chaff cutter to 2-3 cm length.

Production of Chemi-mechanical Pulps. Two types of high yield pulps, were produced :

(i) Cold Soda Pulps
(ii) Alkaline Sulphite Pulps

(i) *Production of Cold soda Pulps.* Cold soda pulps were prepared by soaking the cut kenaf (200 gm o.d. basis) in the caustic soda solution (6.6-10 gpl at room temperature till it was completely impregnated The soaked material was washed with fresh water and refined, keeping the clearance of 15, 10 and 5 mils successively The pulps were washed and their yield was determined. The pulps were beaten in PFI mills to about 250 ml freeness using standard conditions. The standard sheets were prepared and tested for their strength properties, brightness and opacity using standard methods. The results on strength properties obtained are recorded in Table 1.

(ii) *Production of Alkaline Sulphite Pulps.* Alkaline Sulphite Pulping was carried out in a series digester, which consists of six bombs each of 2.5 litres capacity rotating in an electrically heated polyethylene glycol bath.

Two types of buffers were used in alkaline sulphite pulping :

(i) Sodium Carbonate
(ii) Sodium hydroxide

In all experiments 200 gm material (o.d. basis) was taken in each bomb and pulping was carried out using sodium sulphite (4-8%) and buffered with either sodium carbonate or sodium hydroxide (1%) at 130°C for a period of 2 hours including 45 minutes to raise the temperature to maximum. Material to liquor ratio of 1 : 6 was maintained.

The softend material was washed and refined; the pulps so obtained were evaluated for their yield and strength properties as in case of cold soda pulps. The results are recorded in Table 2 and Table 3.

Blending of Pulps. The strength properties and brightness of the pulps obtained as above were further improved by blending the various pulps with a commercial bleached bamboo pulp (obtained from Central Pulp Mills, India) in the ratio 70 : 30 The standard sheets were prepared and tested for various properties as usual. The results are recorded in Tables 4–6.

Table 1

Cold-soda Pulping of Kenaf

Chemical (NaOH) gpl.	Pulp yield (%)	Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa. m^2/g)	Folding endurance	Brightness % ISO	Opacity (%)
6.6	76.0	26.17	1.13	3.34	.55	2	29.8	95.8
10.0	71.5	34.58	1.04	3.95	.90	4	30.2	96.2

Table 2

Alkaline Sulphite Pulping of Kenaf (Using Sodium Carbonate).

Chemicals (Na_2SO_3)	pulp yeild (%)	Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa m^2/g)	Folding endurance	Brightness % ISO	Opacity (%)
4	81.2	22.49	1.18	4.58	.64	2	47.3	97.1
5	78.8	25.37	1.12	4.48	.61	2	45.8	98.9
6	74.4	20.80	1.31	5.09	.59	2	45.7	97.1

Table 3

Alkaline Sulphite Pulping of Kenaf (Using sodium hydroxide)

Chemical (Na_2SO_3) (%)	Pulp yield (%)	Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa. m^2/g)	Folding endarance	Brightness % ISO	Opacity (%)
4	88.4	18.23	.98	3.99	.19	2	53.1	96.8
6	82.6	17.40	.90	3.50	.15	1	52.1	96.4
8	77.7	23.26	1.0	4.78	.49	2	50.3	96.2

Table 4

Blending of Kenaf Cold soda : Bamboo Pulps

Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa. m^2/g)	Folding endurance	Brightness % ISO	Opacity (%)
26.47	1.20	3.58	.61	2	43.7	98.1
36.63	1.14	4.47	.91	6	42.7	97.2

Table 5

Blending of Kenaf Alkaline Sulphite : Bamboo Pulps

Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa. m^2/g	Folding endurance	Brightness % ISO	Opacity (%
25.38	1.43	4.43	.69	2	47.8	97.4
26.79	1.36	5.37	.73	3	49.6	96.9
21.89	1.30	5.44	.58	3	48.2	96.2

Table 6

Blending of Kenaf Alkaline Sulphite : Bamboo Pulps

Tensile Index (N.mg)	Stretch (%)	Tear Index (mN. m^2/g)	Burst Index (Kpa. m^2/g)	Folding endurance	Brightness % ISO	Opacity (%)
19.91	1.22	4.64	.32	2	57.1	96.1
20.90	1.25	4.38	.45	2	54.5	95.9
24.10	1.18	4.92	.66	3	52.6	95.6

Results and Discussions

The results recorded in Tables 1, 2 and 3 indicate that pulps in high yield ($\simeq$72–88%) could be prepared from kenaf by cold soda and alkaline sulphite processes.

In general, the strength properties of all the pulps are satisfactory. Cold soda pulps have higher strength properties than alkaline sulphite pulps. The yield and brightness of the pulps are much higher in alkaline sulphite pulps. At similar yield value the tensile index and burst index of cold soda pulps and alkaline sulphite pulps are likely to be similar but tear index is more in alkaline sulphite pulps.

The properties of various blends (Table 4, 5 and 6) indicate that the strength properties and brightness of all the pulps have improved. However, opacity of pulps is not much affected

In the present context of acute newsprint shortage, kenaf could be considered as an ideal raw material for making pulps for newsprint furnishes.

SUMMARY

Laboratory scale experiments were carried out on the production of newsprint grade pulps from kenaf by chemi-mechanical pulping processes. Cold-soda, and alkaline sulphite processes were adopted, which could give pulps in high yield ($\simeq$72-88%) having satisfactory strength properties, brightness and opacity. Blending of these pulps with a commercial bleached bamboo pulp further improved the strength properties and brightness.

केनाफ से अधिक मात्रा में लुगदी

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सारांश

रासायनिक और यान्त्रिक प्रविधियों द्वारा केनाफ से अखबारी कागज ग्रेड की लुगदी बनाने के प्रयोगशाला स्तर पर संपरीक्षण किये गए। इसके लिये ठंडा सोडा और समाक्षारीय सल्फाइट प्रविधियां अपनाई गई जिनसे अधिक मात्रा में (72 से 88%) संतोषजनक शक्ति विशेषताओं, चमक और पारांधता वाली लुगदियाँ तैयार की जा सकती हैं। व्यावसायिक विरंजित बांस लुगदी में इन लुगदियों को मिला लेने पर इनकी शक्ति विशिष्टताओं और चमक में और भी सुधार हो गया।

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BEEKEEPING, POLLINATION AND PLANT PROPAGATION

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Introduction

Beekeeping is perhaps the only industry which besides production of honey and wax helps to increase the yields of some crops and at the same time helps in maintenance of ecological balance. Beekeeping industry depends on a balanced enviroament in association with tne flowering plants.

Beekeeping Industry

In India there are four honey bee species, namely, the Indian hive bee (*Apis cerana* Fab.), the giant honey bee or rock bee (*A. dorsata* Fab.), the little honey bee (*A. florea* Fab.), and the dammar bee (*Trigona iridipennis* Smith). Of these, the former species only can be reared in modern movable frame hive and are easy to handle. *A. cerana* colonies are restricted mainly to forest areas. About 0.7 million bee colonies of *A. cerana* are maintained and about 5 million kilograms of honey is produced from these colonies. Nearly 150,000 beekeepers come from forest, tribal or rural communities and depend on beekeeping for their livelihood. Some of the leading states in beekeeping are Kerala, Tamil Nadu, Karnataka, Bihar, Assam and Orissa. The main beekeeping areas in India are the Western Ghats, Eastern Ghats, Sub-Himalayan tracts and North-Eastern India.

Beekeeping is one of the village industries, the development of which is entrusted to the Khadi and Village Industries Commission, a statutory body of the Government of India. The Commission executes the beekeeping programmes through the state Khadi and Village Industries Boards and under them, Co-operative Societies and Registered Institutions. The Beekeeping Directorate of the Commission organises and implements this programme through a set of patterns of assistance approved by the Commission. Beekeepers get subsidy on hives, honey extractors, tools, etc. and technical guidance in managing their colonies and assistance in marketing their produce.

Beekeeping and Agriculture

Besides honey production, beekeeping has a much more important role in cross-pollination of agricultural crops, Several of our oilseed, vegetable, legume, pulse and fodder crops as also plantation and orchard crops like orange, lemon, coffee, cardamom and cocopalm depend on insects like honey bees for cross-pollination and yield more seed/fruit of better quality than when no insects are present.

In nature the useful pollinating insects are decreasing day by day due to several reasons. The main contributing factor for this is indiscrete use of insecticides on various crops. This not only retarded or even destroyed the populations of beneficial insects, but has also affected indirectly the production of oilseed and other crops, by killing a number of valuable pollinators.

The oilseed, pulse and fruit production can be augmented by providing bee colonies to these crops during their flowering period. Bee pollination results not only in yield increase but also in improvement in their quality. Provision of bee colonies during the flowering of crops is a simple, less expensive, but essential input. There is an acute edible oil shortage in our country. India is importing edible oil to the tune of Rs. 6000 million from other countries to meet the shortage. The oilseed production will continue to show decreasing trend in future, unless adequate steps are taken now itself to keep bee colonies in the fields of these crops during their flowering period.

The main constraint in developing beekeeping as an integral part of agriculture is the absence of food to the honey bees throughout the year in the agricultural farms. The bees can get forage during the flowering season of the crop, but starve in the remaining period. In order to get the benefits of bee pollination, the farmers have to provide for bee forage when there are no crops flowering in the farms. Various trees and shrubs can be plantad along hedges, borders, bunds and waste lands which can provide nectar and pollen to bees. In addition, the farmers can also introduce several crops like coriander, maize, niger, sunflower, lucerne and berseem in crop rotation schedules. These crops provide valuable bee forage when needed and at the same time augment the income of the farmers trough their produce.

Constraints in the progress of Beekeeping

Beekeeping in India is still largely a forest based industry. The main hurdle for the progress of beekeeping in the country is deforestation. The depletion of bee forage in the forests results in decreasing number of bee colonies and lower honey production. Recently, beekeeping activity in some areas has shifted to agri-horticultural areas. Rape-seed and mustards, niger, gingelly, coriander, berseem, litchi, lemon and orange are some important crops which provide food to the bees. However, here beekeeping is faced with the problem of insecticides. The indiscriminate use of insecticides by the farmers and orchardists to control insect pests also affects bee colonies.

Plant Propagation

Both agriculture and forestry are necessary for beekeeping. The evergeen and semi-evergeen forests and transitional belts between farms and forests are particularly favourable for beekeeping. The forests are the permanent locations of natural honey bee colonies, where they produce honey and multiply in number generally during spring. But large scale deforestation in many parts of the country and thus depleting forage from forests results in the desertions and dwindling of bee fauna in them. Afforestation with plants useful to bees as sources of bee forage round the year helps beekeeping. This will also develop the forest as a biological unit maintaining an ecological balance. A systematic programme of reforestation with bee plants can, in a few years time, sustain large number of bee colonies which can also provide gainful self-employment to the local forest or tribal population. The benefits of such a programme will start accruing after five to ten years. Therefore, if this is not done now, we may have to face very serious problems in forestry and agriculture five to ten years later. It is necessary to take up large scale afforestation programme as soon as possible. The plant species selected for afforestation, social and farm forestry can have dual utility as sources of food to bees and as sources of timber, fruit, medicine, etc.

The programmes of social forestry, afforestation of waste agricultural lands, denuded forests and grass lands assume special significance in the national rural development programmes. In addition to utilising these waste lands for providing additional income to the farmers or tribal population, this can also allow undertaking beekeeping both for honey production and increased crop production through bee pollination. In view of this, the Central Bee Research Institute, Khadi and Village Industries Commission, prepared a list of plants which are useful for timber, fruit and other purposes and also as source of bee forage. The important bee plants useful for social forestry are listed below.

The beekeeper himself can do much by undertaking bee plant propagation and by encouraging others to do the same. He should provide for supplementary bee forage near his apiary by planting various bee plants to get flowers throughout the year.

The department of forests in every state maintains nurseries of forest species. Important tree species useful to honey bees could be identified and included in their afforestation programme and to raise a large supply of seedlings. Planting material can thus be obtained from the nurseries of the forest department.

Some important bee plants useful for Social Forestry

In the following list common names in regional languages are given, wherever known. The language is indicated in brackets : Eng : English; H : Hindi; Tam : Tamil; Tel : Telugu; Kan : Kannada; Mal : Malayalam; S : Sanskrit; Guj : Gujrati; Ben : Bengali; O : Oriya; A : Assamese; Mar : Marathi; P : Punjabi.

Acacia sinuata (Lour.) Merr.

Common names : Soap pod tree (Eng); Kochi, Ritha (H); Skikai (Tam); Chikake (Mal); Manda-otte, shige, sige balli (Kan); Shikaya (Tel); Shikekai (Mar); Chikakai (Guj); Bhuripena, dipta, phena, saptata, vidula (S); Bon-Ritha (Ben).

Economic use : Soapnut; bark for dyeing and tanning, live fence: firewood.

Method of propagation : Seed.

Aegle marmelos (Linn.) Corr.

Common names : Baeltree, Bangal quince (Eng); Bel, bili (H); Vilvam (Tam); Koovalam (Mal); Bela, baelpatri, bilapatri (Kan); Maredu (Tel); Bel (Mar); Bil (Guj); Bilva (S); Bel (Ben).

Economic use : Fruits edible, medicinal, timber.

Method of propagation : Seed.

Bombax ceiba Linn.

Common names : Red silk cotton (Eng); Semul, semur, pagun, shembal (H); Ilava (Tam); Elavu, pulamaram (Mal); Buruga, burla, sauri (Kan); Booruga (Tel); Lal savar (Mar); Sawar (Guj); Salmali, rakthapushpa (S); Bouro (O); Simul (Ben).

Economic use : Seed fibre; timber; avenue tree.

Method of propagation : Seed.

Ceiba pentandra (Linn.) Gaertn.

Common names : White silk cotton, kapok tree (Eng); Hatian, katan, safed-simul, senibal (H); Ilavu (Tam); Panya (Mal); Dudimara, bulilurga, marali (Kan); Kateswar, shamieula (Mar).

Economic uses : Seed fibre, timber, avenue tree.

Method of propagation : Seed.

Elaeis guineensis Jacq.

Common name : African oil palm (Eng).
Economic use : Palm oil from fruits, ornamental.
Method of propagation : Seed.

Emblica officinalis Gaertn.

Common names : Emblic myrabolan (Eng); Amla (H) ; Nellikai (Tam); Nelli (Mal); Nelli (Kan); Usirikai (Tel); Avla (Mar); Amala (Guj); Adiphala (S); Aura (O); Amlika (Ben).

Economic use : Fruits edible, medicinal.

Method of propagation : Shield budding.

Limonia acidissima Linn.

Common names : Wood apple (Eng); Kait, bilin (H); Vilanga (Tam); Vila, Vilatti (Mal); Byala (Kan); Velaga (Tel); Kavath, kavith (Mar); Kavit, kotha (Guj); Kait, katbel (Ben).

Economic use : Fruit edible; gum; wood.

Method of propagation : Seed, cutting, layering.

Leucaena glauca Benth.

Common names : Soobabul (H; Mar); Tagarai (Tam); Takaranniram (Mal); Kaniti (Tel); Lasobaval, vilayatibaval (Guj); Rajokasundiri (O).

Economic use : Green manure, fodder, timber, firewood, etc.

Method of propagation : Seed.

Moringa oleifera Lamk.

Common names : Drum stick tree (Eng); Sainjana, senja (H); Murangai (Tam); Murunga (Mal); Kochka, nuggi (Kan); Munaga (Tel); Shevga (Mar); Sargavo (Guj); Shobonjana (S); Munagha (O); Sohajna (Ben); Saijna (A); Soanjna (P).

Economic use : leaves, flowers and fruits eaten as vegetable; gum; medicinal; firewood.

Method of propagation : Seed, cuttings.

Pongamia pinnata (Linn.) Pierre

Common names : Indian beech Eng); Karanja (H); Pangam (Tam); Punga (Mal); Ponge, huligalli, karanj maru (Kan); Ganuga (Tel); Karanja (Mar); Kanaji, karanji (Guj); Koranjo (O); Darkaranja (Ben); Karchew (A), Sukhchain (P).

Economic use : Non-edible oil, medicinal, timber, firewood.

Method of propagation ; Seed, Cuttings.

Sapindus species

Common names : Soap nut tree (Eng); Ritha (H); Puvamkottai (Tam); Pasakotta (Mal); Anthuvala, Kugala phenilu (Kan); Kunkudu (Tel); Ritha (Mar); Aritha (Guj); Aristha (S); Muktamanji (O); poor Ritha (Ben); Reitha (P).

Economic use : Fruits used as soap; timber; shade tree.

Sesbania grandiflora Pers.

Common names : Basna, bak; agusta, hatiya (H); Agathi (Tam); Agathi (Mal); Agase, kempangase (Kan); Avesi (Tel); Hadga, Agati (Mar); Agathio (Guj); Agasthya (S): Buko (O); Buka (Ben).

Economic use : young leaves, flowers and fruits eaten as vegetable fodder; firewood.

Method of propogation : Seed.

Syzygium cumini Skeels.

Common names : Black or Java plum (Eng); Jamun (H); Naval (Tam); Naga (Mal); Jambul (Mar); Jambudi, Jambura (Guj); Jamo (O); Kalajam (Ben); Jambu, neralu (Kan); Neredu (Tel); Jammu (P).

Economic use : Fruits edible; medicinal.

Method of propagation : Seed.

Tamarindus indica Linn.

Common names : Tamarind tree (Eng); Imli (H); Puli (Tam); Puli (Mal); Amla amlika, amlike, hunase (Kan); Chinta (Tel); Chinch (Mar); Amli (Guj); Tentul (O); Tentuli (Ben); Tetuli (A); Imbli (P).

Economic use : Fruits and young leaves edible, condiment, tartaric acid, timber, firewood.

Method of propagation : Seed.

Terminalia chebula Retz.

Common names : Chebulic myrabolan (Eng); Harad (H); Kadukai (Tam); Kadukka (Mal); Alate, Heerda, Haritaki (Kan); Karaka (Tel); Hirda (Mar); Hirdo (Guj); Harida (O); Hara (Ben); Silikha (A); Harar (P).

Economic use : Bark for tanning and dyeing, fruits medicinal, timber.

Method of propagation : Seed.

Ziziphus species

Common names : Chinese date, Indian cherry plum (Eng); Ber (H); Ilanthai (Tam); Cherumali (Mal); Bogarai, bore, Ilanji (Kan); Regu (Tel); Bor (Mar); Ber, Bordi (Guj); Ajapriya (S); Boyer (O); Ber (Ben).

Economic use : Fruits edible, fodder, oil from seed useful for industrial purposes, firewood, a good plant for afforestation in dry areas on poor soils and in rocky places.

Method of propagation : Seed, grafting.

EFFICACY OF EGG PARASITE, *TRICHOGRAMMA* SPP. IN PARASITISING THE EGGS OF THE TEAK SKELETONIZER, *PYRAUSTA MACHAERALIS* WALKER (LEPIDOPTERA : PYRALIDAE)*

B.V. PATIL** AND T.S. THONTADARYA***

Department of Entomology,
College of Agriculture, Dharwad (Karnataka)

Introduction

The teak skeletonizer, *Pyrausta machaeralis* Walker (Syn : *Hapalia machaeralis* Wlk.) is one of the serious insect pests of teak, *Tectona grandis* L.f. and is known to affect adversely its growth increment (Beeson, 1941). Extensive survey of natural enemies of the pest indicated two egg parasites *T. minutum* Riley and *Trichogrammatoidea nana* Zehntner (Beeson, 1938). Field releases and recovery study of these egg parasites which is very much essential to establish the potentiality of egg parasites in teak skeletonizer management, especially in plantation areas in completely wanting in the past.

Materials and Methods

The present study was carried out to know the efficiency of three *Trichogramma* species viz; *T. evanescens* Westwood, *T. brasiliensis* Ashmead, and *T. pkcal* (hybrid) which proved most effective in parasitising the teak skeletonizer under laboratory conditions (Patil, 1981).

Five hectares of three year old teak plantation was selected for this study. The three species of parasites, which were bred and multiplied on skeletonizer eggs under field conditions for two generations were released individually at a distance of 100 m from each other. A control was also maintained. About 5000 parasites of each species were released during the third week of October, 1979. The releases was dependent on the egg stage occurrence of the pest in the field which was clearly indicated by life-table studies in the adjacent plantation area and also based on the peak catches of adults at petromax light-trap.

Parasite recoveries were started after two days of release by taking three leaves at the rate of one leaf from top portion, one from middle portion and one from bottom portion in each plant. Likewise ten plants were selected in each parasite released block and also from control. The leaves were brought to the laboratory for further examination of the egg population under sterioscopic binocular microscope.

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* Part of the Ph.D. thesis submitted by the Senior author to U.A.S., Bangalore.

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Similarly on seventh and 15th day after release the recoveries were made, Afterwards the recoveries were made till 120 days at 15 days interval after release (February). The eggs of other insects were also collected from the plantation area to find out the parasites emergence.

Results and Discussion

Based on the investigations in laboratory, the three exotic parasites, *T. evanescens*, *T. brasiliensis* and *T. pkcal* were selected for field release in Prabhunagar forest with the objective to find out their establishment and survival capacity in plantation areas. These three *Trichogramma* species were released in moderately infested three year old teak plantation area at isolated distances during the month of October. Recoveries of the parasitised eggs was quite high immediately after two days of release and also seven days of release in all the three species. But the parasitisation declined considerably after 15 days of release (Table 1). This is mainly attributed to two factors. Firstly, the host egg, *P. machaeralis* population itself decreased after 15 days of release and secondly there was heavy rain (61.8 mm) during the period which might have reduced both the host egg population and also the adult *Trichogramma* parasites. This was further supported by reduction of host egg population in control block during the same period. The investigation also pointed out that only *T. pkcal* was recovered upto 105 days of release, whereas *T. brasiliensis* and *T. evanescens* were recovered upto 90 and 60 days of release respectively. After 120 days of release (third week of February) the parasites were not recovered. Perhaps, this may be due to considerable reduction in host egg population and also due to high temperature existence (Fig. 1) during the period.

In the past, Beeson (1938, 1941) and Beeson and Chatterjee (1939) had released *T. minutum* and *Trichogrammatoida* sp. in Nilambur plantation area after importing them from Karnataka and Burma respectively, but they failed to recover the parasites on *P. machaeralis* eggs from plantation area. But on the contrary, the present investigation clearly indicated the establishment of three exotic *Trichogramma* sp. in Prabhunagar teak plantation area on *P. machaeralis* eggs and also suggests that inundative high population releases of the *Trichogramma* parasites may prove effective in regulating the population of *P. machaeralis.*

These *Trichogramma* egg parasites were also found to parasitise other lepidopterous eggs (Table 2) which were observed in the teak plantation area.

Table 1

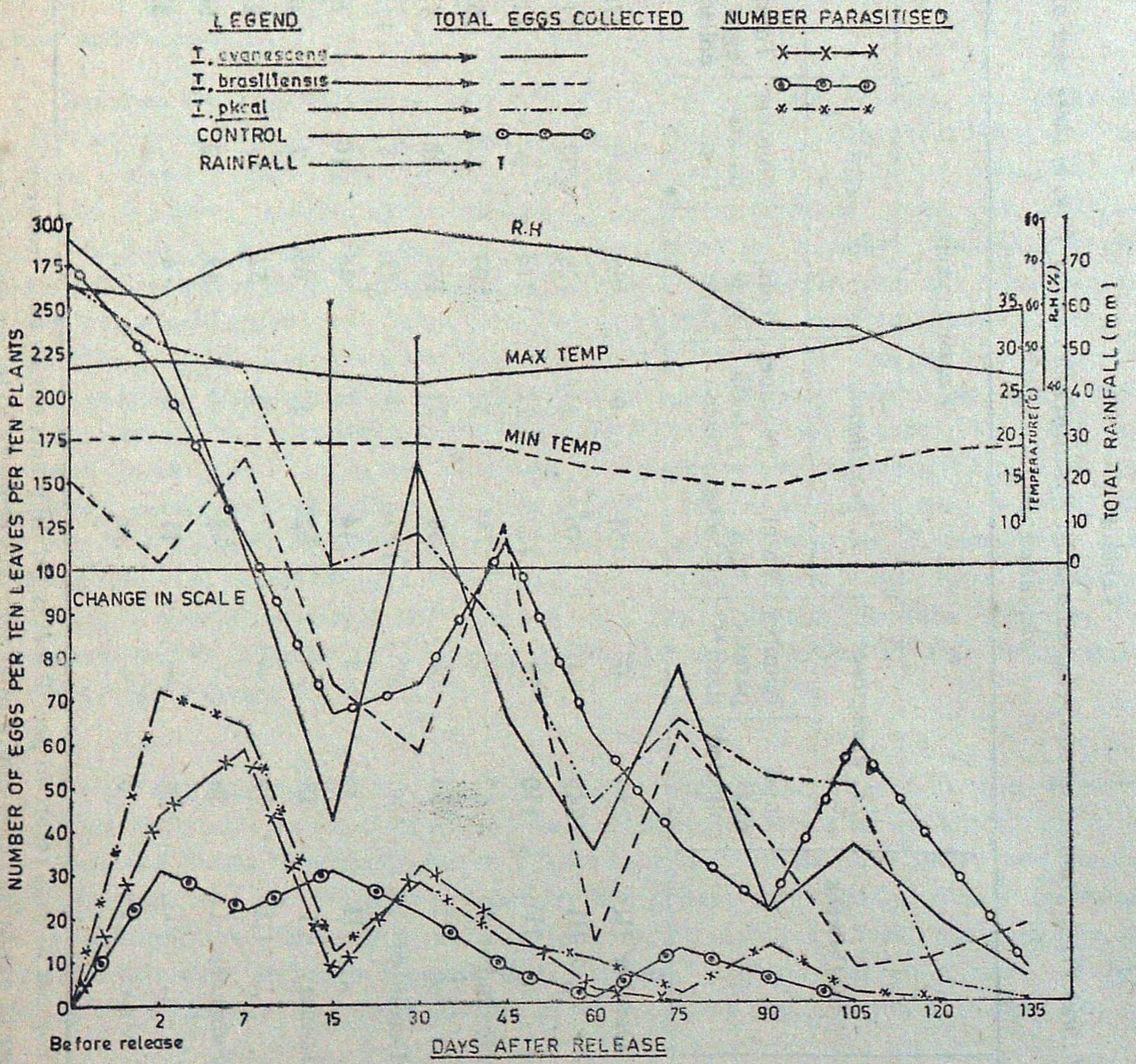
Recovery of three Trichogramma species released against Pyrausta machaeralis Wlk. in three year old teak plantation area

Period of release	Month/week	Parasite species							
		T. evanescens		*T. brasiliensis*		*T. pkcal*		Control	
		Total eggs collected*	Number parasitized**	Total eggs collected	Number parasitized	Total eggs colle	Number parasitized	Total eggs collected	Number parasitized
Before release	October III	290	0	151	0	265	0	276	0
2 days after release	,, III	245	44	103	31	228	72	215	0
7 days ,,	,, IV	110	59	162	22	214	64	117	0
15 days ,,	November I	42	6	74	31	103	12	67	0
30 days ,,	,, III	161	32	58	21	121	28	74	0
45 days ,,	December I	66	17	126	8	85	14	113	0
60 days ,,	,, III	35	3	14	1	46	10	62	0
75 days ,,	January I	78	—	62	12	65	2	36	0
90 days ,,	,, III	20	—	37	5	52	13	21	0
105 days ,,	February I	36	—	8	—	49	2	60	0
120 days ,,	,, III	18	—	11	—	4	—	33	0
135 days ,,	March I	5	—	18	—	0	—	7	0

* Total number of eggs recorded per 30 leaves per 10 plants during each recovery.

** Number of parasitised eggs out of total eggs collected per 30 leaves per 10 plants.

Fig. 1



Recovery of three *Trichogramma* sp. released against *Pyrausta machaeralis* Wlk. in the Prabhunagar Teak Plantation Area

Table 2

Recovery of Trichogramma parasites from other lepidopterous eggs in the plantation area

Sl. No.	Insect species	Family
1	*Amsacta lactinea* Cramer	Arctiidae
2	*Diacrisia obliqua* Walker	Arctiidae
3	*Eupterote undata* Blanchard	Eupterotidae
4	*Dirades* sp.	Epiplemidae
5	*Cleora* sp.	Geometridae
6	*Ascotis infixaria* Walker	Geometridae
7	*Hyblaea puera* Cramer	Hyblaeidae
8	*Euproctis fraterna* Moore	Lymantriidae
9	*Dasychira* sp.	,,
10	*Dasychira* sp.	,,
11	*Mocis undata* Fabricius	Noctuidae
12	*Phytometra* sp.	,,
13	*Sylepta* sp.	Pyralidae
14	*Margaronia vertumnalis* Guenee	,,
15	*Pagyda* sp.	,,
16	*Hyposidra talaca* Walker	Geometridae
17	*Hyposidra* sp.	,,

Acknowledgements

The authors are grateful to the staff, Department of Farm Forestry, College of Agriculture, Dharwar for their kind help. The Senior author is thankful to the UNDP/ICAR/UAS for awarding a senior research fellowship during the period of study.

SUMMARY

Three exotic *Trichcgramma* species, namly *T. pkcal*, *T brasiliensis* and *T evanescens* when released against the teak skeletonizer, *Pyrausta machaeralis* Wlk. in teak plantation area during October survived upto 105, 90 and 60 days respectively, indicating their possible establishment and survival capacity when released in large numbers.

सागौन के पर्ण कंकालक कीट, पायराउस्टा मैकेरैलिस वाकर (शलिकपक्ष : पायरालिडी) के अंडों का परजीवीकरण कराने में अंडा परजीवी कीट, ट्राइकोग्रामा प्रजा० की उपयोग क्षमता

लेखक बी०वी० पाटिल व टी०एस० ठोंटादार्या

सारांश

ट्राइकोग्रामा की तीन परदेशीय जातियाँ अर्थात् ट्रा० ओक्सल, ट्रा० ब्रैजिलियेंसिस और ट्रा० इवेनेसेंस सागौन पर्णकंकालक प्रायराउस्टा मैकेरैलिस के विरुद्ध सागौन रोपवन क्षेत्र में अक्तूबर में छोड़ी जाने पर क्रमश: 105, 90 और 60 दिन तक जीवित बची रही हैं जिससे उनके अधिक संख्या में छोड़े जाने पर उनके स्थापित हो सकने और जीवित बने रहने की क्षमता का संकेत मिलता है।

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RESEARCH NOTE

EXPERIMENT OF POLLARDING OF *ACACIA AURICULAEFORMIS* FOR PRODUCTION OF BIOMASS

Centre : Gamharia Research Centre, Singhbhum Distt.
Species : *Acacia auriculaeformis*
Object : Determination of Biomass at the age of 4½ years.
Year of planting : 1979.
Rainfall : 72 cm. Dry months March, April, May, Oct. & November.
Soil : pH 6.5 Texture clay.
Date of cutting : 24-3-84.
Legnth at the time of cutting : 10.10 metres.
Diameter (D.B.H.) at the time of cutting – 7.1 cm (dia class 5-10 cm)

Tree has been cut into pieces of one metre length each and its weight and volume are given here under :

Piece No.	Length (metre)	Weight (Kilogram)	Diameter		Average volume (m^3)
			Bottom dia. (cm)	Top dia. (cm)	
1	1	7.5	10.1	8.4	0.00677
2	1	5.5	8.0	8.4	0.00528
3	1	4.0	7.0	7.1	0.00391
4	1	3.5	6.1	5.4	0.00260
5	1	2.5	5.4	5.0	0.00212
6	1	2.0	5.0	4.0	0.00161
7	1	1.3	4.0	3.1	0.00101
8	1	1.0	3.2	2.1	0.00057
9	1	0.3	2.1	0.3	0.00018
9	9.00	27.6	10.1>	<0.3	0.02405

	Weight in kg
Branches	6.3
Leaves with scantalies	6.3
Fruit	0.8
	13.1
Total weight of the tree	27.6 + 13.1 = 40.7 Kg

Volume is calculated by $\pi r^2 h$ formula at bottom diameter and at top diameter and taking average of both the volumes which gives average volume indicated above.

From the above data it may be considered that approximately 6.3 + 0 8 = 7.1 kg of biomass are being given at the age of $4\frac{1}{2}$ in terms of leaves and pods every year excluding 40.7 kg in the year of felling.

Research & Evaluation Division,
Ranchi (Bihar)

Upendra Prasad

CONVOCATION OF FOREST COLLEGES HELD ON APRIL 2, 1984 AT FOREST RESEARCH INSTITUTE AND COLLEGES, DEHRA DUN

HIGH LIGHTS OF THE SPEECHES

WELCOME SPEECH BY SHRI C.S. KIRPEKAR, PRESIDENT. FOREST RESEARCH INSTITUTE AND COLLEGES, DEHRA DUN

It is my proud privilege to extend a warm and hearty welcome to our Rashtrapati, Giani Zail Singh, on the occasion of the combined convocation of the Forest Colleges. I, also, heartily welcome our Minister for Agriculture, Rao Birendra Singh, and Shri C.L Bhatia, Inspector General of Forests, who inspite of Parliament being in session have found time to join us in this function.

Forest Research Institute & Colleges have played a pivotal role by undertaking major programmes of forestry research, education and training. With a humble beginning in 1878, the Institute has been passing through various stages and its activities have considerably expanded during the successive Five Year Plans. Apart from the main campus at Dehra Dun, which undertakes research in 31 disciplines of forestry and forest products, the Institute has established four regional research centres at Bangalore, Coimbatore, Jabalpur and Burnihat for carrying out research in different eco-climatic regions of the country. In addition, it has taken up a number of multi-disciplinary field oriented projects such as high level conifers, watershed management, agro-forestry, minor forest products, etc. Besides there are nine forest colleges under this Institute for education and training of Forest Officers. The Institute has been recognised by the Indian universities as a Centre for research, leading to Doctoral and Post-doctoral programmes. It has also been recognised by the F.A.O. as a Centre for forestry research and education in South-East Asia.

The young foresters who are passing out today are fortunate that they are entering the Forest Service at a time when these big programmes are on the anvil. As trusted officials of the Governments, at various important levels, they have a special responsibility to ensure that the programmes are executed with utmost efficiency and in the public interest. They have been suitably trained in all fields for this purpose and, I am sure, they will come up to the expectations I wish them good luck and God speed.

SPEECH BY RAO BIRENDRA SINGH, MINISTER FOR AGRICULTURE, GOVT. OF INDIA

It is indeed a great pleasure for me to speak on the occasion of the combined Convocation of the Forest Colleges and the Social Forestry Diploma Course at this renowned Institute. For the F.R.I. it is a momentous event that the President of India is delivering the Convocation Address to Forest Officers. We are highly grateful for his presence.

I am glad to note that women are now coming to work as forest officers. I wish more and more women wood feel interested in forestry, particularly in social forestry and forestry education for the benefit of the young students and rural women-folk.

It is heartening to note that many officers from the neighbouring countries are also passing out today, after successful completion of their training here. This is a concrete step in the field of international cooperation. I hope they will prove assets in their own countries.

I heartily congratulate all the I.F.S probationers and the trainees for the successful completion of their training and wish each one every success in a very important as well as challenging career ahead.

* * *

CONVOCATION ADDRESS BY GIANI ZAIL SINGH, PRESIDENT OF INDIA

It is indeed a great pleasure for me to be with you here today, amidst these sylvan surroundings that you have nurtured over the years, and the gracious buildings that evoke the splendour of a bygone age. A new batch of young officers is being added to the Indian Forest ervice, the State Forest Service and the Range Officers' cadres of various States today. I also understand that the Second Social Forestry Diploma Course, the first of its kind in India, is coming to successful completion and inservice officers trained are passing out today.

To all of you—successful students and trainees—I offer my congratulations. You have successfully completed your training course here at the Forest Colleges. This entitles you to get a degree or a diploma or a certificate in forestry and also write certain qualifications with your names. But the real challenge of life eagerly awaits you. This challenge will have no examination, no diploma, but would require your selfless service for the rest of your career. Life itself is the testing ground, and the reward. In short, it is only from now onwards that your mettle, your abilities and qualities as a human being and a public servant, would be put to test.

I am happy to notice that the slogan "Tree for Every Child" is increasingly becoming popular throughout the country. In fact, I would like to go a step further and add that

Shri C.S Kirpekar delivering the Welcome Address

Hon'ble Rao Birendra Singh addressing the gathering

Hon'ble Giani Zail Singh, delivering the Convocation Address

Shri C L. Bhatia, proposing the Vote of Thanks every citizen should consider it as his fundamental duty to plant and grow a tree, as his contribution to the country.

I am glad to know that amongst you are also some forest officer trainees from the neighbouring and friendly countries of Afghanistan, Bhutan and Nepal for receiving their forestry diplomas. I extend my congratulations and good wishes to them. I am also very happy to see that many ladies have joined the Forest Service and passed through the course here. I congratulate them heartily. I also congratulate all the prize winners.

I thank the Honourable Minister of Agriculture, Rao Birendra Singh, for providing me an opportunity to come here for addressing this Convocation.

* * *

VOTE OF THANKS BY SHRI C.L. BHATIA, INSPECTOR GENERAL OF FORESTS, GOVT. OF INDIA

It is my pleasant duty and an honour to propose a Vote of thanks to Hon'ble Giani Zail Singh Ji, President of India, who kindly spared his valuable time and graced this solemn occasion. In the history of this Institute this is the second visit by the First Citizen of the country. The first was by the then President Dr. Rejendra Prasad on 6th December, 1956, in connection with the Golden Jubilee Celebrations of the F.R.I. & Colleges. Your visit, Sir, for this Convocation, is the first of its kind and shall be remembered as the most memorable visit of the highest dignitary of the Nation. This visit has amply demonstrated your special concern and love for trees and the science of forestry. At the same time, it has greatly benefitted and boosted the morale of all the forest officers and scientists engaged in the profession of forestry. Sir, the sapling that you are going to plant in the FRI campus today, shall be an embodiment of this memorable event.

I also express my sincere gratitude to the Hon'ble Union Minister for Agriculture, Rao Birendra Singh Ji for gracing this occasion. It his under his dynamic and pragmatic leadership that forestry has taken several significant strides. The enactment of the Forest Conservation Act, 1980, the revision of the National Forest Policy and the implementation of the Social Forestry Programme, are just a few to quote. I thank you Sir, for your kind patronage and presence on this occasion.

To the young officer trainees who are passing out today, I congratulate and wish them a very bright career. As a profession it is challenging, rewarding and satisfying to be a forester. I am confident that the high quality of training that has been imparted to you shall stand you in good stead.

LIST OF PRIZE WINNERS

INDIAN FOREST COLLEGE

The Dean, Indian Forest College, announced that 99 Indian Forest Service Probationers including 3 ladies and 13 foreign trainees : 2 from Afghanistan, 1 from Bhutan and 10 from Nepal including 1 lady trainee, have successfully completed their training and they are awarded the Diplomas—Associate of Indian Forest College.

The names of the prize winners :

1. Shri T. Sekar	(i) Minister of Agriculture Prize for the top student (ii) College prize for Utilization, and (iii) Dr. R.N. Mathur Memorial Prize for Entomology.
2. Shri S.P. Vasudeva	(i) S.K. Seth Memorial Prize for the most talented forester, (ii) College Prize for the best all-round student and most practical forester, and (iii) Sulochana Naidu Memorial Prize for Co-curricular activities.
3. Shri K.S. Sugara	College Prize for Management, Mensuration and working plan.
4. Shri S.N. Singh	College Prize for Engineering and Surveying
5. Km. Pritima Tiwari (Nepal)	(i) Minister of Agriculture Prize for the top student from a foreign country, (ii) V.S. Rao Prize for the top student from a foreign country, and (iii) College Prize for Botany.
6. Dr. A.K. Singh	(i) D.C. Agarwal Prize for Land Management and Soil Conservation (ii) K.P. Sagreiya Shreshtha Vanik Puruskar for Forestry subjects.

7.	Shri Pradeep K. Pant	E.P. Gee Prize for Wildlife Management.
8.	Shri G. Hari Kumar	Hill Memorial Prize for Silviculture
9.	Shri N. Krishna Kumar	Nilgiri Wildlife Club Prize for the best Essay on Wildlife, 1984.
10.	Shri A K. Pattnaik	Society of Indian Foresters Prize for the best Working Plan.
11.	Smt. Anjana Shukla	Indian Forester Prize.

Shri T. Sekar who tops the list is being recommended for the award of Currie Scholarship.

* * *

STATE FOREST SERVICE COLLEGE

The Principal, State Forest Service College announced that all 65 trainees have successfully completed the Diploma Course in Forestry.

The names of the prize winners :

1.	Shri A.K. Tiwari	(i) Minister for Agriculture Prize for top student. (ii) College Prize for Engineering and Surveying.
2.	Shri H.K. Sarma	College Prize for Forest Utilization.
3.	Shri Sudhakar Misra	College Prize for Forest Management and Working Plan.
4.	Shri R.S. Nathawat	College Prize for best all-round student and most practical forester.
5.	Shri D. Swain	Wildlife Prize for essay contest.
6.	Shri Anwar Ahmed	College Prize for best sportsman of the year.
7.	Shri F.A. Ahmed	Kaushik Medal for Soil Conservation and Management.
8.	Shri A.K. Srivastava	Raizada Silver Medal for Botany.
9.	Shri M.R. Bhanj	Choudhary Ram Prakash Prize for Silviculture.
10.	Shri R.B.S. Kushwaha	Society for Indian Forester's Prize for best Working Plan.

* * *

NORTHERN FOREST RANGER'S COLLEGE

The Principal Northern Forest Rangers college announced that all the 34 trainees have successfully completed the One-year Ranger Certificate Course.

The names of prize winners :

1. Shri P.L. Chauhan (H.P.)	(i) Honours Gold Medal for the student who gets the highest Marks. (ii) Mc. Donal Silver Medal for the best student from H.P., Punjab, Haryana and J. & K. (iii) Silver Medal for Forest Botany. (iv) Fernandaz Medal for Forest Utilization. (v) Chaturvedi Shield for the best marksman among the Colleges, (vi) Wild Life Club Prize.
2. Shri N.C. Madhwal (U P. Forest Corp.)	(i) Silver Medal for Forestry, (ii) Stracey Prize for Wildlife Management.
3. Shri A.K. Sharma (J & K Forest Corp.)	Indian Forester Prize.
4. Shri S.B. Singh (U.P. Forest Corp.)	Hazarika Memorial Prize for the best student who does best in tour examination.
5. Shri S.K. Pandey (M.P.)	Silver medal for Forest Engineering.
6. Shri D.S. Nain (B.P.I.)	Jubilee Prize for the best sportsman of the year.
7. Shri R.K. Singh (H.P.)	K.L. Agarwal Prize for Soil Conservation.
8. Shri. A.R. Malik (J & K)	Silver Cup for Marathon Race—for the winner of the race.
9. Shri R.K. Debnath (T.F.C.)	Choudhary Ram Prakash Prize for Surveying.
10. Shri G.H. Harazi (J & K Forest Corp.)	William Prothero Thomas Prize for the most practical forester.
11. Shri V.P. Kanaujia (U.P. Forest Corp.)	Silver Medal for Range Administration.

* * *

SECOND DIPLOMA COURSE IN SOCIAL FORESTRY

1. Shri K. Autar (Madhya Pradesh)	Union Minister of Agriculture Prize for the participant who stood first.
2. Shri T.H. Mallikarjuna (Karnataka)	Secretary of Agriculture Prize for the participant who stood second.
3. Shri Laleng Liana (Mizoram)	Padma Shri K.M. Tiwari Prize for the best Dissertation on Social Forestry.

* * *

HOWARD MEDAL

The award for the year 1983 is being given to Shri N.K.S. Bora, Research Asstt. Grade-I of Forest Ecology Branch for his work on "Distribution of Organic Matter in *Cryptomaria japonica* plantations".

* * *

BAKSHI MEMORIAL MEDAL

This year's award is being given to Shri Sujan Singh, Senior Research Officer, Forest Pathology Branch for his research work in 1983 pertaining to "Gummosis, brown spot and seedling mortality disease of Su-babul *(Leucaena leucocephala)*".

* * *

DR. A. PURUSHOTHAM SILVER MEDAL

This year the awards are being made to the following persons who were awarded Ph.D. Degree in the subject mentioned against their names :

Name	*Subject*
1. Dr. K.N. Bahadur Officer-in-Charge, Systematic Botany Branch.	"Monographic studies on the Genus Toona (Meliaceae)."
2. Smt. Rajni Dang, Dehra Dun.	"Studies on Pine Lignin."
3. Dr. S.M. Sharma, O.N.G.C.	"Chemical studies on lignosulphonate complexes."

4.	Km. Sushma Mahajan, R.A.Grade-I, C. & P. Branch.	"Studies on the Chemistry of Sulphite Pulping of *Eucalyptus globulus*."
5.	Dr. S.P. Singh, R.A. Grade-I, C. & P. Branch.	"Studies on Chemical Modification of Wood to Improve Durability and Physical Properties."
6.	Dr. S. Irfan Ahmed, Research Officer, Research Centre, Burnihat.	"Studies on the Morphology Bionomics, Ecology and Digestive Physiology of *Calopepla leayana* Latr. (Chrysomelidae : Coleoptera)."

* * *

WOOD PRESERVATION AWARD

The best research worker award for the year 1982–83 is awarded to Shri P.B. Bodriyal, Research Assistant Grade-I of Wood Preservation Branch for his outstanding work on fundamental studies on flow paths in hardwoods.

The best artisan award for the year 1982–83 has been given to Shri Davendra Prasad Khalasi, Wood Preservation Branch for his contribution to erection of low cost structures using bamboo and thatch.

REVISED RULES OF THE BRANDIS PRIZE FUND

(Effective from 1st January, 1984)

1. The Brandis Memorial Trust Prize Fund was formed from part of the subscription made by the officers of the Forest Department as a testimonial to Sir Dietrich Brandis, K.C.I.E. when he retired in 1884.

2. The Fund will continue to be operated by the Honorary Editor in consultation with the President, Forest Research Institute and Colleges, Dehra Dun, who is also ex-officio President, of the Central Editorial Board of the *Indian Forester*.

3. The annual permanent income of the Fund is to be utilised for payment of prizes to members of the Forest Department in India, who make original contributions to the *Indian Forester* on the theory and/or practice of silviculture and kindred subjects.

4. The financial position of the Fund at present is as follows :

(a)	Investment in Govt. Securities and F.D.R.	... Rs.	37,600.00
(b)	In Saving Bank Account	... Rs.	2068.89
(c)	Approximate Annual Income	... Rs.	2520.50

5. Five annual prizes will, therefore, be given as follows :
   - (a) Two prizes of Rs. 300/- (in cash) each, for the best original contributions on any subject connected with the theory and/or practice of Indian Silviculture.
   - (b) Two prizes of Rs. 300/- (in cash) for the best original contributions on any subject akin to silviculture, including reviews of forestry publications and items of correspondence.
   - (c) A prize of Rs. 100/- (in cash) for the best cover photograph.

6. Preference will normally be given to contributions on silvicultural subjects, observations recorded in forest work, description of forest tracts, forest management, etc.

7. Contributions of less than one printed page of the *Indian Forester* or more than 30 pages, will not usually be considered.

8. If in any year no contribution is considered worthy of a prize, none need be awarded. The amount awarded in each case will depend upon the value of the contribution and the funds available.

9. In the event of a tie between two or more contributions considered worthy of prize the prize money will be equally divided between them.

10. For contributions under joint authorship, prize money will be distributed equally amongst the authors.

11. The awards will be decided each year by the Central Editorial Board for contributions printed in the *Indian Forester* during the previous year. These decisions, once announced, will be final and published in the *Indian Forester*.

Hony. Editor,
Indian Forester.

REVISED RULES OF THE SCHLICH PRIZE FUND

(Effective from Ist January, 1984)

1. The Schlich Memorial Trust Prize Fund was formed from decennial grants to India of the annual interest on the capital (£ 1,700) by the trustees (The Empire Forestry Association, London) of the Schlich Memorial Trust Fund (1928). This latter fund was started by the friends and admirers of Sir William Schlich, K.C.I.E., F.R.S., at one time Inspector General of Forests to the Government of India and founder of the forest services monthly magazine the *Indian Forester*, to commemorate his great services to the cause of forestry. The trustees decided that the interest on the sum collected should be paid each year, in rotation, to different parts of the British Empire and to the United States of America, and devoted to some purpose to further the cause of forestry.

2. The fund henceforth will be administered by the Honorary Editor in consultation with the President, Forest Research Institute, Dehra Dun, who is also ex-officio President of the Central Editorial Board of the *Indian Forester*.

3. In concurrence with the Chairman, Empire Forestry Association, London, the Chief Trustee of the Schlich Memorial Trust Fund (1928), it was decided to utilize the decennial grant to this country to make an annual award of a prize to a forest officer in this country for the best contribution on any branch of forestry, published in the *Indian Forester*.

4. One annual prize will therefore be given as in rule 3 above, for the best original contribution on any branch of forestry other than silviculture.

5. Contributions of less than one printed page of the *Indian Forester* or more than 25 pages, will not usually be considered.

6. If in any year no contribution is considered worthy of a prize, none need be awarded. The amount awarded in each case, will depend upon the value of the contribution and the funds available.

7. The financial position of the above prizs fund is as under :

(a)	Investment in Fixed Deposit	... Rs.	1500.00
(b)	In Saving Bank Account	... Rs.	699.96
(c)	Approximate Annual Income	... Rs.	150.00

8. The prize will be of Rs. 100.00 and will be in cash.

9. In the event of a tie between two or more contributions, considered worthy of the prize, the money will be equally divided between them.

10. The award will be decided each year by the Central Editorial Board for contributions printed in the *Indian Forester* during the previous year. The decision, which will be final, will be announced each year in the journal.

Hony. Editor,
Indian Forester

REVISED RULES OF THE CHATURVEDI PRIZE FUND

(Effective from 1st January, 1984)

1. The Prize is formed out of the interest on a sum of Rs. 1,000 (Rs. One thousand) kindly donated by Shri M.D. Chaturvedi, IFS, (Retd.) our first Indian Inspector General of Forests.

2. The fund will be administratred by the Honorary Editor, *Indian Forester* in consultatuion with the President, Forest Research Institute and Colleges, Dehra Dun, who is also ex-officio, President of the Central Editorial Board of the *Indian Forester*.

3. The interest will be utilised to make a biennial prize for the best contributions on any matter pertaining to Wild Life published in the *Indian Forester*.

4. If no contribution is considered worthy of a prize, no prize will be awarded and the prize money will be carried forward.

5. The prize is normally expected to be of the value of Rs. 75.00 (Rs. Seventy Five) depending on the yield the investment will give, which may vary from time to time, and awarded in cash.

6. The financial position of the fund is as follows :

(a) Invested in preferance shares	... Rs.	1000.00
(b) In Saving Bank Account	... Rs.	640.16
(c) Approximate Annual Income	... Rs.	30.00

7. In the event of a tie between two or more contributions considered worthy of the prize, the prize money will be divided equally among them.

8. The award will be decided every alternate year by the Central Editorial Board for the best contribution published in the *Indian Forester* during the previous two years. The decision of the Central Editorial Board on all matter pertaining to this prize will be final and will be announced in the *Indian Forester*.

Hony. Editor,
Indian Forester

RULES OF THE S.K. SETH MEMORIAL PRIZE FUND

(Effective from 1st Jaunary, 1984)

1. The S.K. Seth Memorial Prize Fund is formed from the subscriptions received from the Forest Officers of Forest Department of India to foster the memory of Late Shri S.K. Seth, I.F.S., Inspector General of Forests, for his great services to the cause to Indian Forestry.

2. The financial position of the above prize fund is as under :

(a)	Investment in Fixed Deposit	...	Rs. 9000.00.
(b)	In Saving Bank Account	...	Rs. 803.52.
(c)	Approximate Annual Income	...	Rs. 720.00.

3. The fund will be administrated by the Honorary Editor, *Indian Forester* in consultation with the President, Forest Research Institute and Colleges, Dehra Dun, who is also the ex-officio, President of the Central Editorial Board of the *Indian Forester.*

4. The annual permanent income will be utilised to make awards of two prizes on the two best original contributions by member of the Forest Department in India on the subjects Environment, Ecology and allied disciplines published in the *Indian Forester.*
   (a) The contribution can be on any topic connected with the theory and/or practice of these disciplines.
   (b) Each prize will be Rs. 300/– to be awarded annually in cash.

5. In the event of a tie between two or more contributors considered worthy of the prize, the prize money will be divided equally between them.

6. For contributions under joint authorship, prize money will be distributed equally amongst them.

7. If in any year no contributions are considered worthy of the prize, no prize will be awarded and the prize money will be carried forward.

8. The awards will be decided each year by the Central Editorial Board for contributions, published in the *Indian Forester* during the previous year. The decision, which will be final, will be announced in the *Indian Forester.*

Hony. Editor,
Indian Forester

OBITUARY

Shri Ram Chandra Prasad

(1926-1984)

Born on 2nd January, 1926 at Gaya (Bihar) Shri R.C. Prasad had a brilliant academic career obtaining a gold medal in M.Sc. Chemistry from Patna University. He successfuly underwent a 2 years Diploma Course in Forestry in the Indian Forest College, Dehra Dun and joined the Bihar Forest Department. He served in various Divisions and lastly posted as Forest Research Officer.

On promotion as Conservator of Forests, he was assigned a highly challenging task in the newly created Departmental Working Circle, Hazaribagh. He was taken as initial recruit in IFS in 1966.

He went on deputation in December 1966 to Royal Government of Bhutan where he got appreciation and affection from His Majesty's Government, for laying the firm foundation of scientific Forest management in Bhutan.

On return, he was posted as Conservator of Forests, Southern Circle, Working Plan and Research Circle and in Development Circle. He had another brief stint of going on deputation for the second time in February, 1978 as Director of Lac Development, Government of India. On being elevated to the rank of Additional Chief Conservator of Forests, he was repatriated back to his State and posted as Additional Chief Conservator of Forests, Development, Bihar in February, 1981 and later on shifted as Managing Director, Bihar State Forest Development Corporation Limited Patna in December, 1981.

He finally rose to the rank of Chief Conservator of Forests, State Trading in November, 1983 and retired from Indian Forest Service on the 31st January, 1984 after serving the 35 years.

He died to the small hours of 30th March, 1984 after a brief illness in Rajendra Medical Hospital, Ranchi.

A very courageous officer and strict disciplinarian Mr. Prasad was popular amongst his friends for the drive in him for any works undertaken by him. He has left behind his three able sons and two married daughters besides a host of friends to mourn his death.

U.P.
and
K.V.

GAZETTE NOTIFICATIONS

F.R.I. GAZETTE

On the recommendations of the Union Public Service Commission, the President, Forest Research Institute and Colleges, Dehra Dun has been pleased to appoint Dr. Syed Irfan Ahmad, Research Assistant Grade I in the F.R.I. and Colleges, Dehra Dun to the post of Research Officer, State Forest Service College-cum-Research Centre, Burnihat (Assam) under the F.R.I. & Colleges, Dehra Dun in the scale of Rs. 650-1200 with effect from 5.12.1983 (Forenoon), until further orders.

On the recommendations of the Union Public Service Commission, the President, Forest Research Institute and Colleges, Dehra Dun is pleased to appoint Dr. Jashbir Singh as Research Officer, Forest Soil-cum-Vegetation Survey, Coimbatore under the Forest Research Institute and Colleges, Dehra Dun with effect from the forenoon of 29th February, 84 until further orders.

KARNATAKA GAZETTE

On return from training abroad Shri S. Nagaraja, IFS., Deputy Conservator of Forests is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Working Plans Division, Mysore.

The following officers borne on the Karnataka Cadre of Indian Forest Service are promoted to officiate as Conservator of Forests, Level I, in the pay scale of Rs. 2000-125/2-2 50 with immediate effect and are continued in their existing posts, namely :

Shri P.D. Gaonkar
Shri G.V. Narayana
Shri G.N. Bulagannavar
Shri B.K. Jagadishchandra
Shri B.S. Parishwad.

The following Indian Forest Service Officers who are out side the regular line are accorded officiating proforma promotion to the Conservator of Forests, Level-I, in the scale of pay of Rs. 2000-125/2-2250 against their juniors promoted in the regular line as indicated below :

Name of the officer	*Junior in the regular line*
Shri U.T. Alwa	Shri P.D. Gaonkar
Shri H.P. Krishnappa	Shri G.V. Narayana

Shri S.R. Bhagwat, IFS., Chief Conservator of Forests, (Development), Karnataka, Bangalore, is promoted and appointed with immediate effect and untill further orders as Principal Chief Conservator of Forests, Karnataka, Bangalore, against the newly created post.

PUNJAB GAZETTE

The President of India is pleased to promote Shri A.K. Aron, I.F.S., D.F.O., Sangrur, as Conservator of Forests, Punjab in the scale of Rs. 1800-100-2000 and the post him as Director, M.C. Zoological Park, Chhat Bir, Chandigarh, relieving Shri A.S. Bhinder, I.F.S., of the additional charge of the post of Director, M.C. Zoological Park, Chhat Bir, Chandigarh with immediate effect.

FRI Publications

FOREST RESEARCH INSTITUTE AND COLLEGES, DEHRA DUN

Indian Forest Leaflets

No. 197—*Wood Working.* Economic conversion of logs. by B.S. Rawat and K.L. Arora. (Symbol No. PFRI. 61.197) Price Rs. 5.00 or £ 0 58 or $ 1.80.

Indian Forest Bulletins

No 272—*Wood Preservation.* Natural resistance of different species of Indian timbers to marine wood-borers in Bombay Waters, by L N. Santhakumaran and K H. Alikunhi. (Symbol No. PFRI. 191). Price Rs 11.50 or £ 1.35 or $ 4.14.

Indian Forest Records

Vol. 1, No. 1—*Forest Influence.* Effect of tree and litter covers on climate near the ground including surface soil temperature and Soil moisture in three forest plantations of Chir (*Pinus roxburghii*) Sal (*Shorea robusta*) and teak (*Tectona grandis*) at New Forest, Dehra Dun, by B.K. Subba Rao and S.K. Pande. (Symbol. No PFRI. 186) Price Rs. 15.75 or £ 1 84 or $ 5 67.

Vol. 2, No 1—*Forest Influence.* Microclimate of Sal coppice forest by R.C. Ghosh, B K. Subba Rao and B.C. Ramola (Symbol No. 165 11. 1). Rs. 43 50 or £ 5.08 or $ 15.66

Vol. 3, No. 1—*Statistical.* Point sampling with a rope – A novel and useful method for forest surveys, by K.R. Satyamurthi (Symbol No. PFRI. 200) Rs. 3.50 or £ 0 41 or $ 1.26

Other Publications

Troup's Silviculture of Indian Trees, Vol III (Revised 1981). (Symbol No. PFRI 188) Price Rs. 89.00 or £ 10.38 or 32 04.

Proceedings of the Eleventh Silvicultural Conference, Dehra Dun, May 1 th to May 25th 1967, Vol. III (1983). (Symbol No. PFRI. 161. III) Rs.195 00 or £ 22 80 or $ 70 38.

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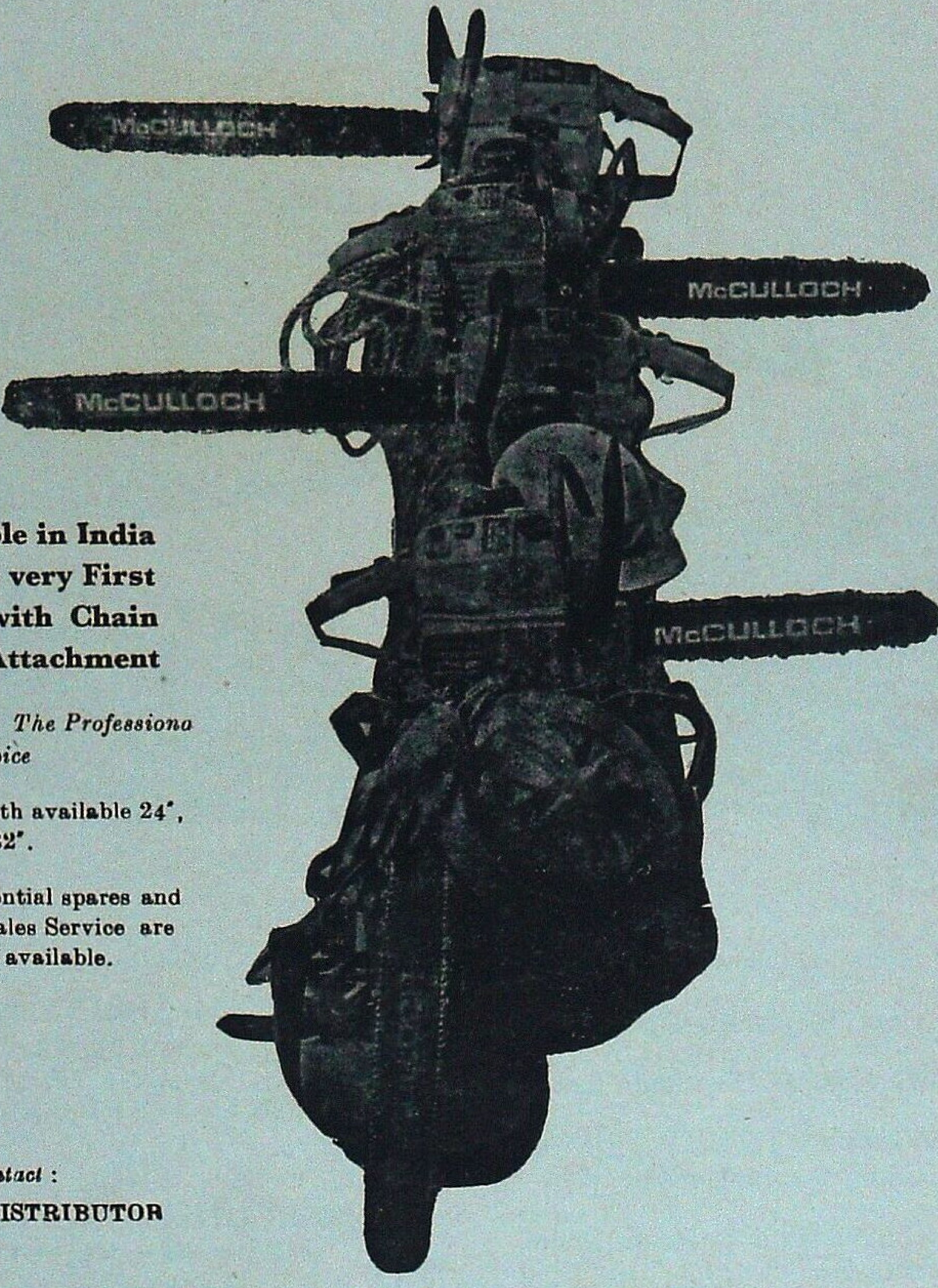

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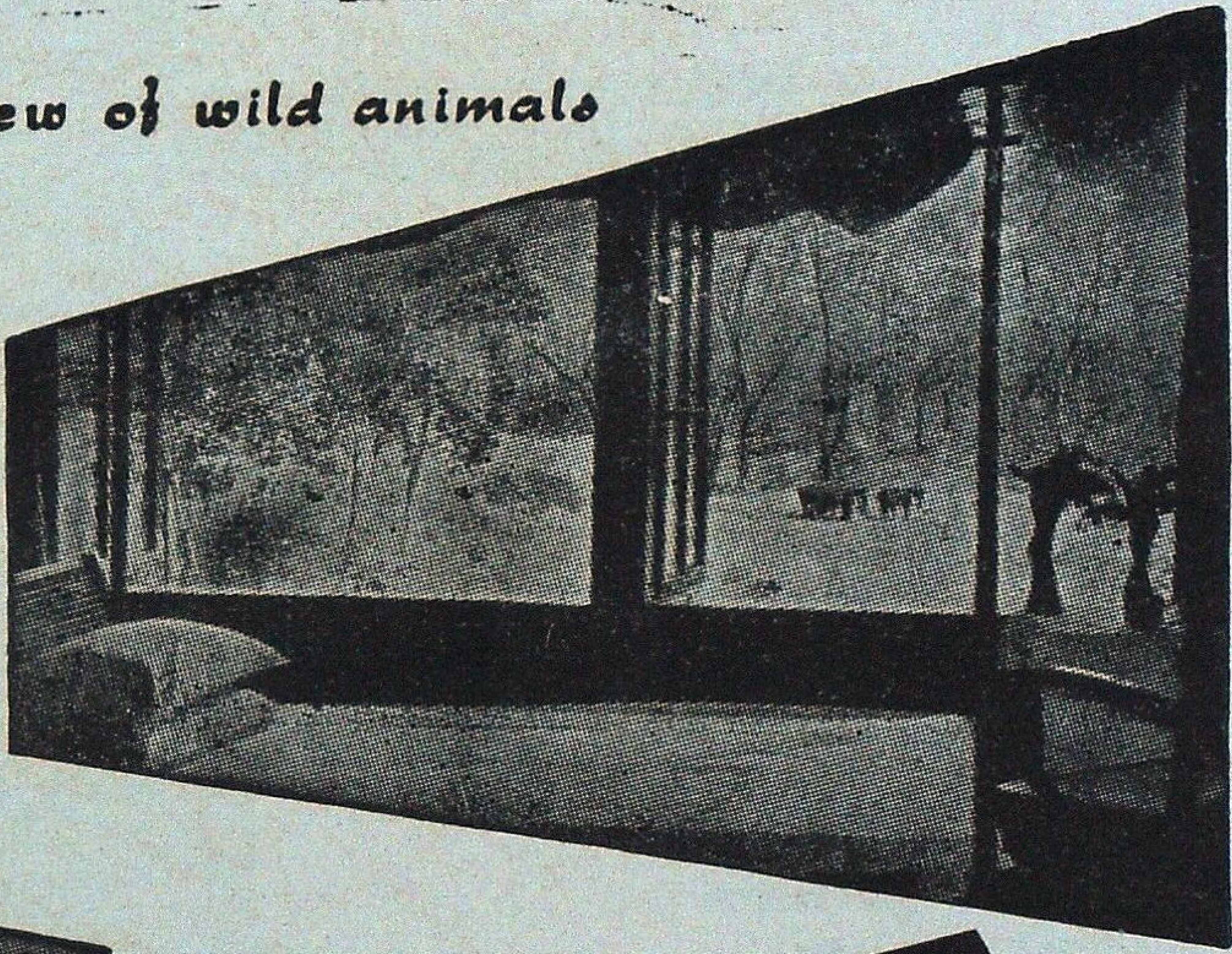

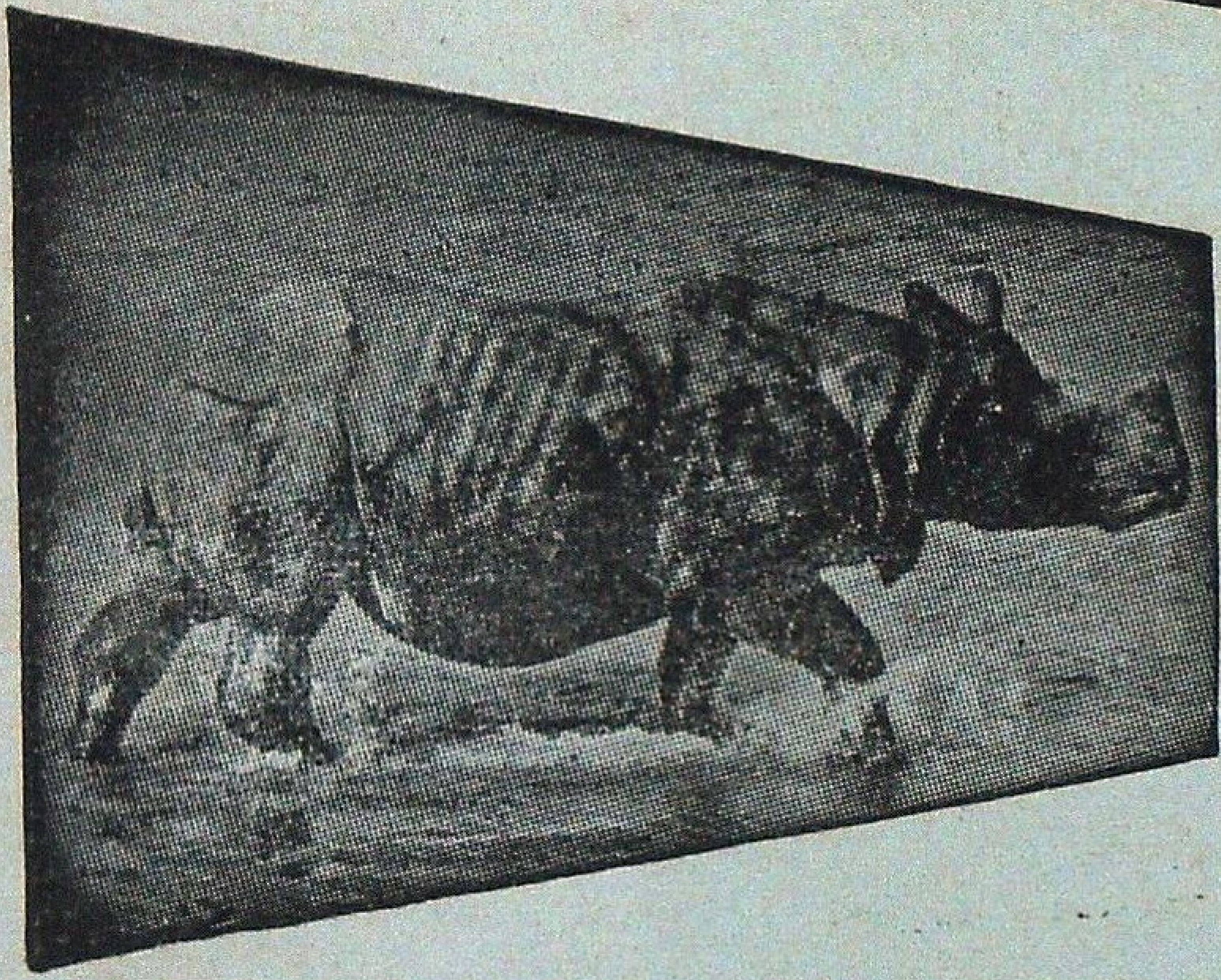

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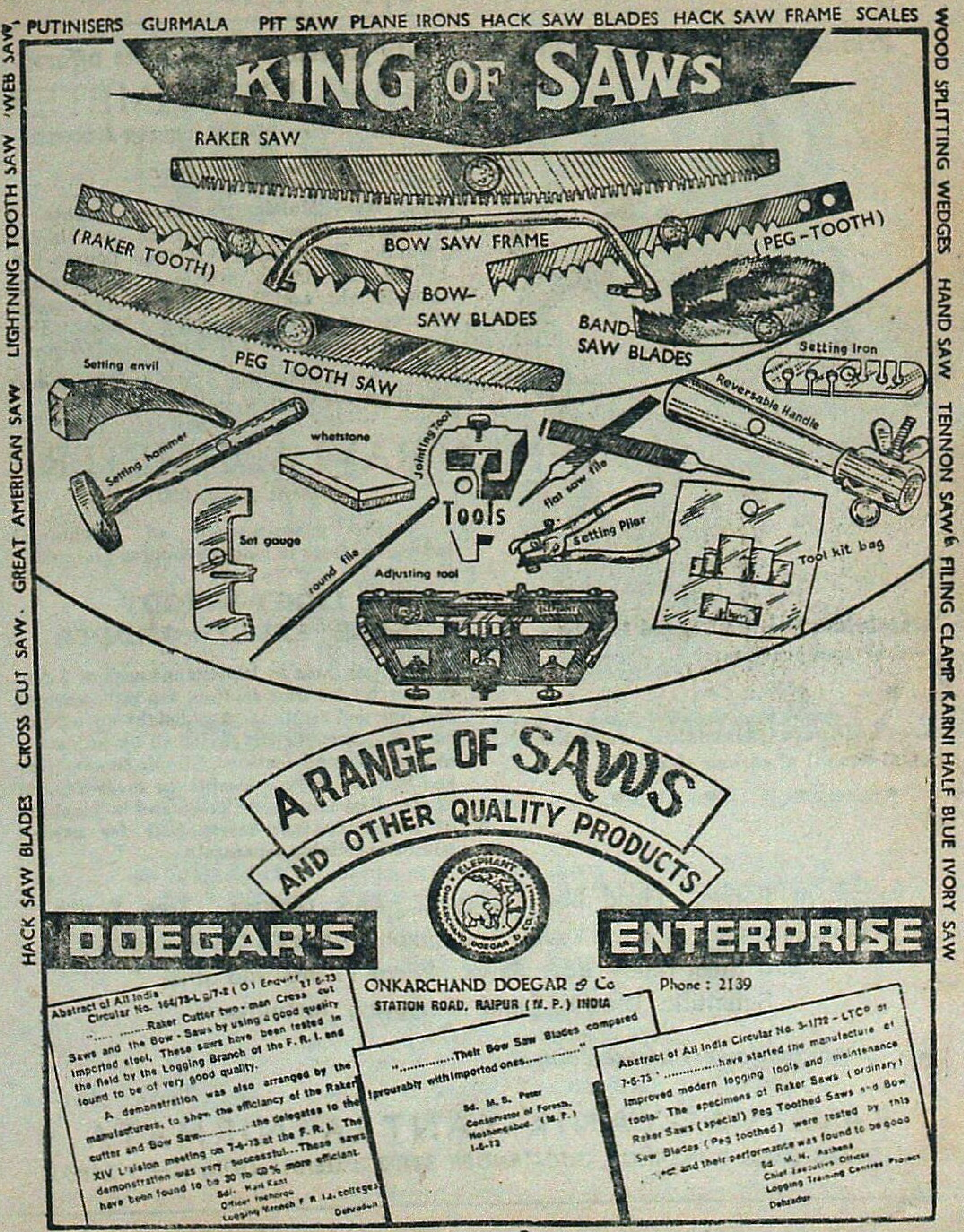
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Officer Incharge
Logging Branch F. R. I. & colleges
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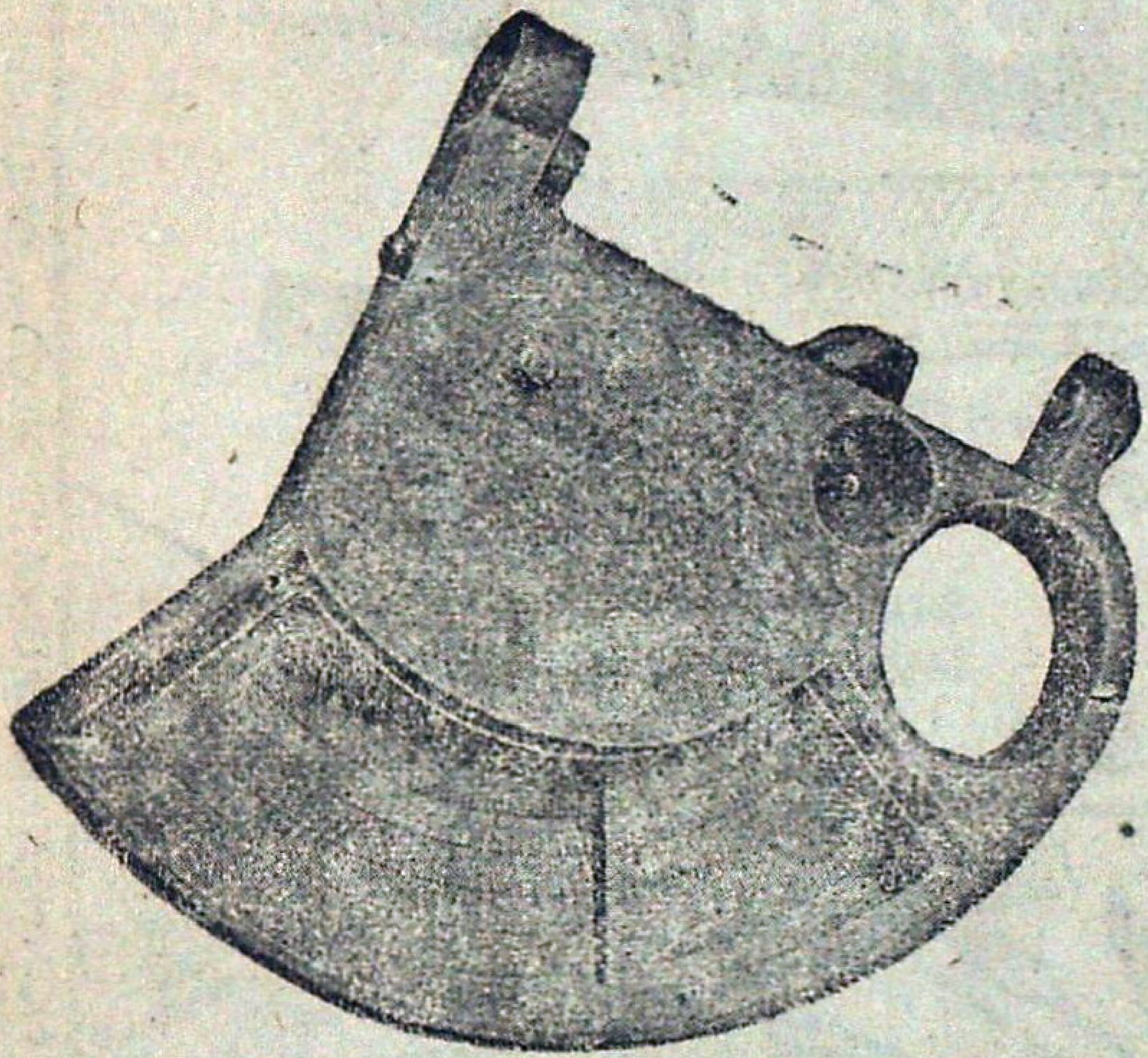

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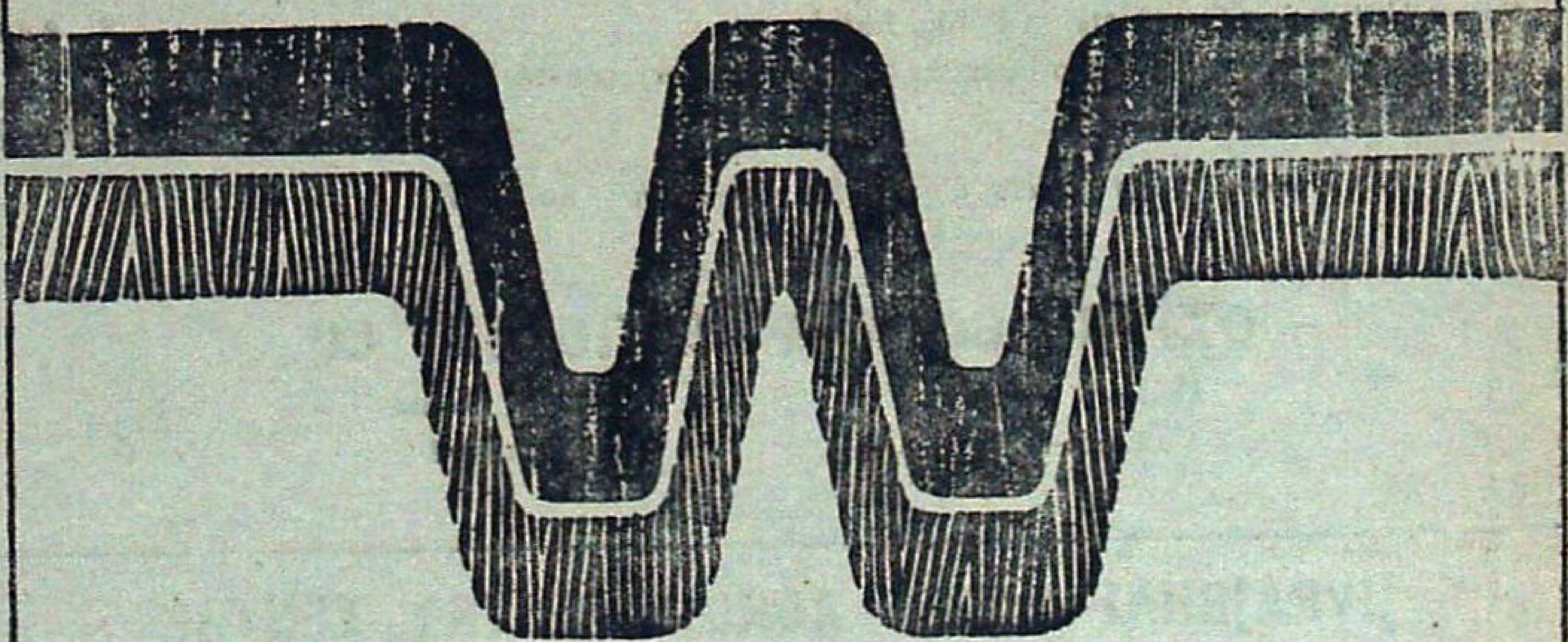

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- Supplier of Sawn Timber and Furniture.
- Cultivators of Coffee, Cardomom, Rubber, Cocoa, Tea and other cash crops.
- Manufacturers of Match and Polythene Bags.

Arunachal Pradesh Forest Corporation Limited

(A Govt. of Arunachal Pradesh Undertaking)

DEOMALI

Regd. Office :—
ITANAGAR—791111
Distt. Sabansiri
(Arunachal Pradesh)

Head Office :—
P.O. Deomali-786629
Distt. Tirap
(Arunachal Pradesh)

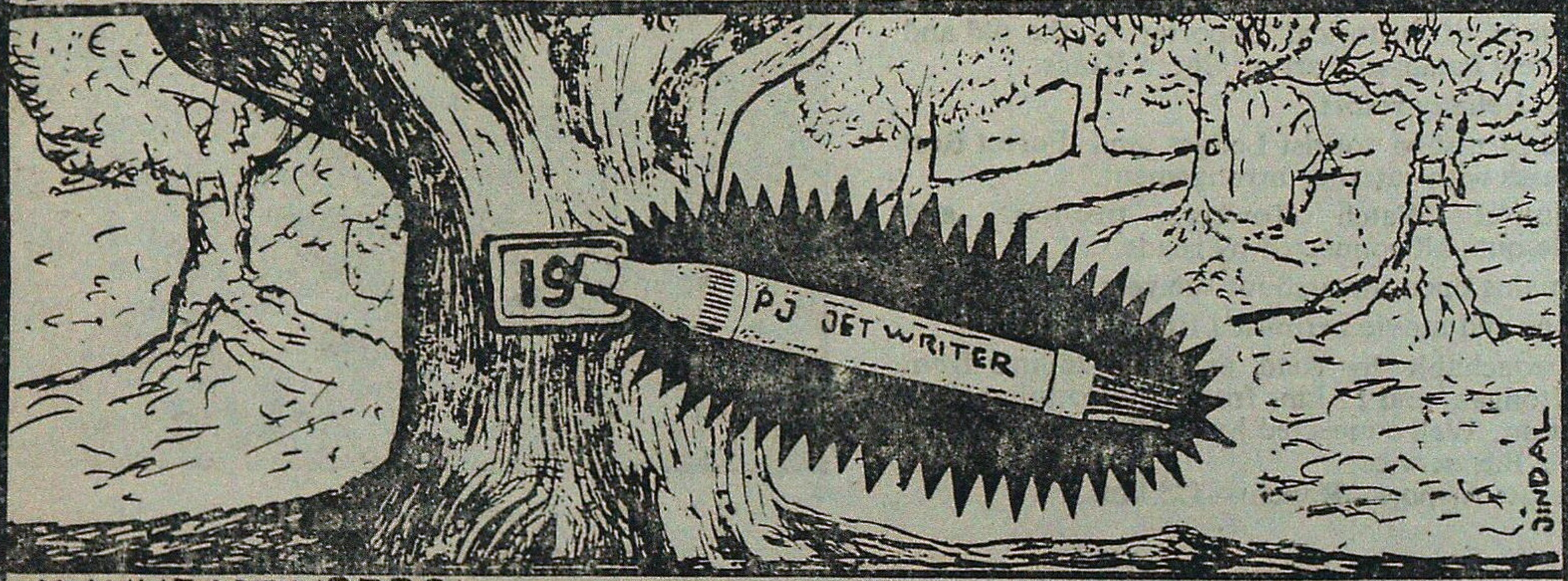
PJ

JET WRITER

DEVICE FOR MARKING TREES

A NOVEL

APPRICIATED, APPROVED & BEING USED IN ALL DIVISIONAL FORESTS OFFICERS.



MANUFACTURERS:-

PIYARA LAL JAGDISH KUMAR INDS...

ANAJ MANDI NABHA GATE

PATIALA (Ph)

अब सातवें वर्ष में—

वन अनुसंधान संस्थान एवं महाविद्यालय, देहरादून के

अखिल भारतीय वानिकी साहित्य पुरस्कार, 1984

वानिकी विषयों पर मूलतः हिन्दी में लिखित वैज्ञानिक व तकनीकी ग्रन्थों और लेखों को देय

ग्रन्थ पुरस्कार :	श्रेष्ठ लेखन पुरस्कार	5,000 रु०
	उत्तम लेखन पुरस्कार	3,000 रु०
	सराहनीय लेखन पुरस्कार	1,000 रु०
लेख पुरस्कार :	श्रेष्ठ लेखन पुरस्कार	500 रु०
	उत्तम लेखन पुरस्कार	300 रु०
	सराहनीय लेखन पुरस्कार	200 रु०
	प्रोत्साहन पुरस्कार	100 रु०

प्रविष्टियां 31 जुलाई, 1984 तक स्वीकार्य

विहीत आवेदन प्रपत्र, नियम व विवरण अपना पता लिखा व बिना टिकट लगा 10 सेंमी०×25 सेंमी० आकार का लिफाफा भेजने पर निम्न से 15 जुलाई, 1984 तक प्राप्य।

दुर्गाशंकर भट्ट
सचिव

अ०भा० वानिकी साहित्य पुरस्कार योजना,
वन अनुसंधान संस्थान एवं महाविद्यालय,
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or

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Forest Department : ORISSA

For details contact :
WILDLIFE CONSERVATION OFFICER, ORISSA,
145-Saheed Nagar, Bhubaneswar-751 007

Phones :
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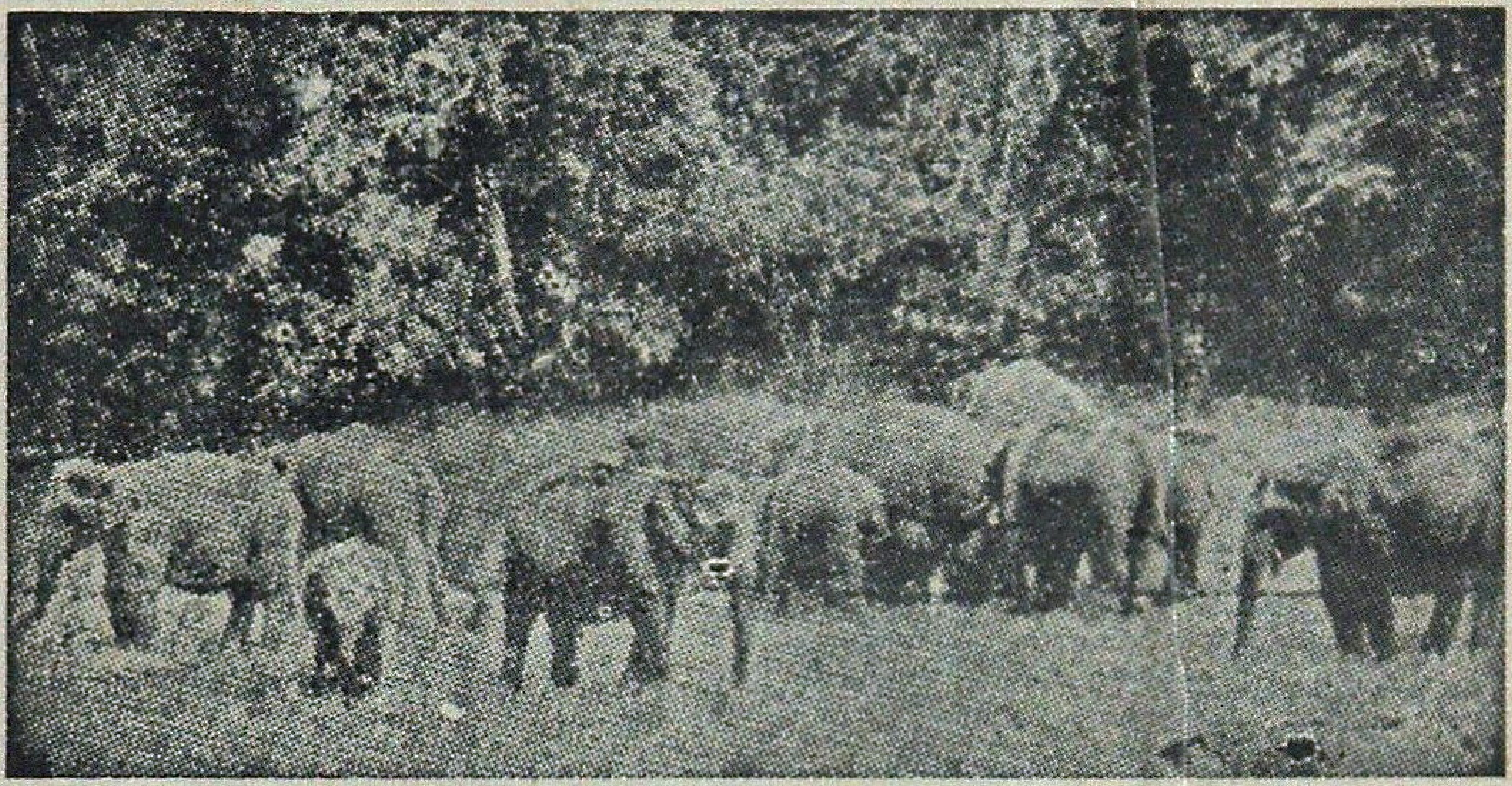

Hotels :
Western Style—Aranya Nivas
Indian Style—Periyar House.
(Accommodation in Hotels reserved by Managers)
†Furnished Forest Rest Houses at Thannikudy, Mullakudy and Manakavala.
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For further particulars contact :—WILD LIFE PRESERVATION OFFICER
Thekkady P.O., (Kerala)
Telephone : KUMILY 27

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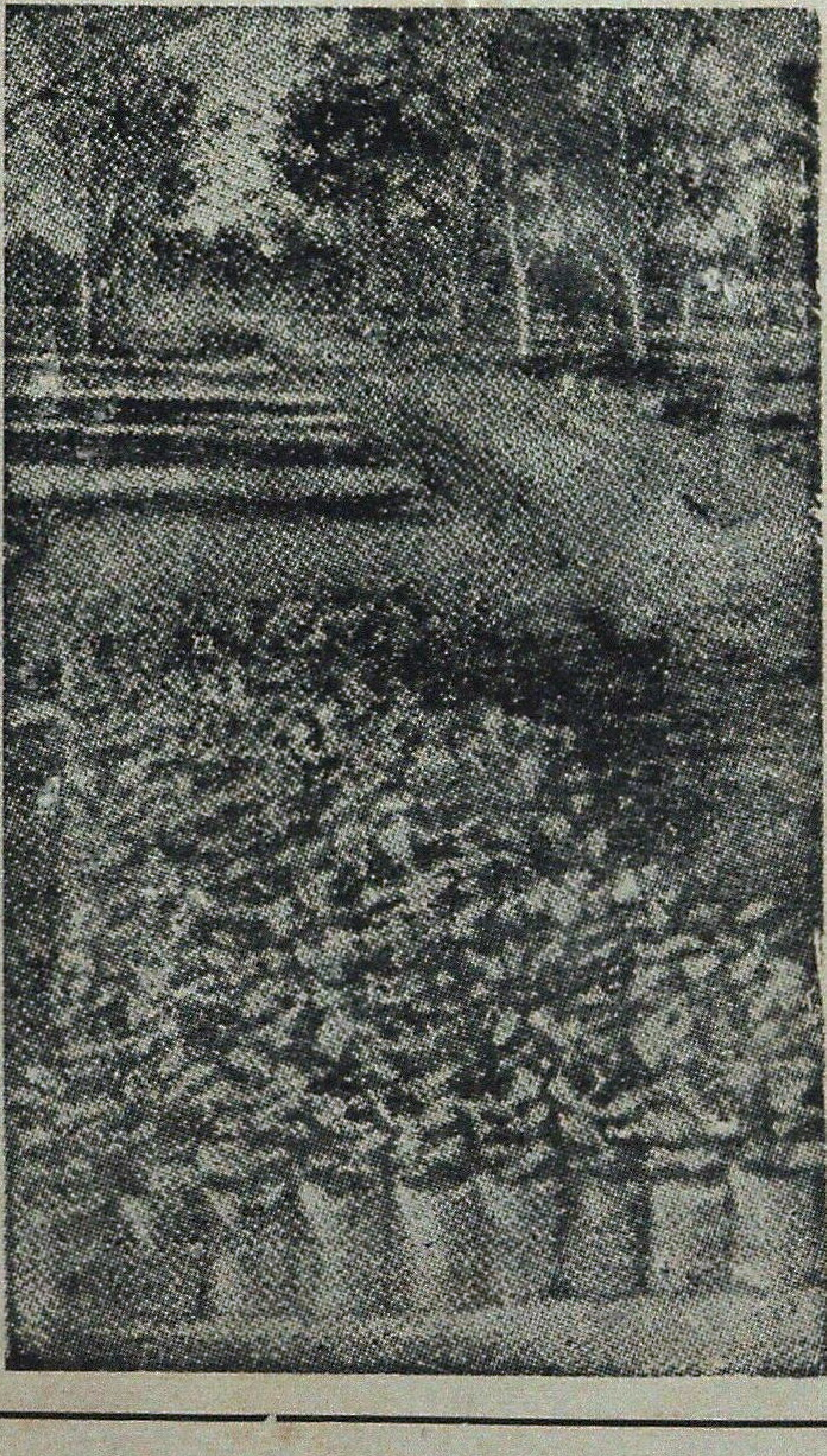

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